

# Scientific and Technical Aerospace Reports

# STAR

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**January 18, 1999**



National Aeronautics and  
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**Langley Research Center**

**Scientific and Technical  
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*Scientific and Technical Aerospace Reports (STAR)* is an electronic abstract journal, listing citations with abstracts for aerospace-related reports obtained from worldwide sources. It is electronically published biweekly and announces documents that have recently been entered into the NASA Scientific and Technical Information (STI) Database. The documents are of the following types:

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*STAR* subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

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## Subject Divisions

Document citations are grouped first by the following divisions. Select a division title to view the category-level Table of Contents.

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## Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for searching on *NASA Thesaurus* subject terms and personal author names.

[Subject Term Index](#)

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## Subject Categories of the Division A. Aeronautics

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### 01 Aeronautics (General)

### 02 Aerodynamics

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information, see also *34 Fluid Mechanics and Heat Transfer*.

### 03 Air Transportation and Safety

Includes passenger and cargo air transport operations; and aircraft accidents. For related information, see also *16 Space Transportation* and *85 Urban Technology and Transportation*.

### 04 Aircraft Communications and Navigation

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information, see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications Radar*.

### 05 Aircraft Design, Testing and Performance

Includes aircraft simulation technology. For related information, see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles, see *85 Urban Technology and Transportation*.

### 06 Aircraft Instrumentation

Includes cockpit and cabin display devices; and flight instruments. For related information, see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

### 07 Aircraft Propulsion and Power

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information, see also *20 Spacecraft Propulsion and Power*, *28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

### 08 Aircraft Stability and Control

Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also *05 Aircraft Design, Testing and Performance*.

### 09 Research and Support Facilities (Air)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information, see also *14 Ground Support Systems and Facilities (Space)*.

## Subject Categories of the Division B. Astronautics

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### **12 Astronautics (General)**

For extraterrestrial exploration, see *91 Lunar and Planetary Exploration*.

### **13 Astrodynamics**

Includes powered and free-flight trajectories; and orbital and launching dynamics.

### **14 Ground Support Systems and Facilities (Space)**

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. *For related information, see also 09 Research and Support Facilities (Air).*

### **15 Launch Vehicles and Space Vehicles**

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information, see also *20 Spacecraft Propulsion and Power*.

### **16 Space Transportation**

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits, see *54 Man/System Technology and Life Support*.

### **17 Space Communications, Spacecraft Communications, Command and Tracking**

Includes telemetry; space communication networks; astronavigation and guidance; and radio black-out. For related information, see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar*.

### **18 Spacecraft Design, Testing and Performance**

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems, see *54 Man/System Technology and Life Support*. For related information, see also *05 Aircraft Design, Testing and Performance*, *39 Structural Mechanics*, and *16 Space Transportation*.

### **19 Spacecraft Instrumentation**

For related information, see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

### **20 Spacecraft Propulsion and Power**

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also *07 Aircraft Propulsion and Power*, *28 Propellants and Fuels*, *44 Energy Production and Conversion*, and *15 Launch Vehicles and Space Vehicles*.

## Subject Categories of the Division C. Chemistry and Materials

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### **23 Chemistry and Materials (General)**

### **24 Composite Materials**

Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials*.

### **25 Inorganic and Physical Chemistry**

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics*.

### **26 Metallic Materials**

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

### **27 Nonmetallic Materials**

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials*.

### **28 Propellants and Fuels**

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

### **29 Materials Processing**

Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology*.



## Subject Categories of the Division D. Engineering

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### 31 Engineering (General)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

### 32 Communications and Radar

Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking*. For search and rescue see *03 Air Transportation and Safety*, and *16 Space Transportation*.

### 33 Electronics and Electrical Engineering

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; micro-miniaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

### 34 Fluid Mechanics and Heat Transfer

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

### 35 Instrumentation and Photography

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

### 36 Lasers and Masers

Includes parametric amplifiers. For related information see also *76 Solid-State Physics*.

### 37 Mechanical Engineering

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

### 38 Quality Assurance and Reliability

Includes product sampling procedures and techniques; and quality control.

### 39 Structural Mechanics

Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

## Subject Categories of the Division E. Geosciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### **42 Geosciences (General)**

### **43 Earth Resources and Remote Sensing**

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography*.

### **44 Energy Production and Conversion**

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

### **45 Environment Pollution**

Includes atmospheric, noise, thermal, and water pollution.

### **46 Geophysics**

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation*.

### **47 Meteorology and Climatology**

Includes weather forecasting and modification.

### **48 Oceanography**

Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

## Subject Categories of the Division F. Life Sciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### **51    Life Sciences (General)**

### **52    Aerospace Medicine**

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

### **53    Behavioral Sciences**

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

### **54    Man/System Technology and Life Support**

Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation*.

### **55    Space Biology**

Includes exobiology; planetary biology; and extraterrestrial life.

## Subject Categories of the Division G. Mathematical and Computer Sciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### **59 Mathematical and Computer Sciences (General)**

### **60 Computer Operations and Hardware**

Includes hardware for computer graphics, firmware, and data processing. For components see *33 Electronics and Electrical Engineering*.

### **61 Computer Programming and Software**

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

### **62 Computer Systems**

Includes computer networks and special application computer systems.

### **63 Cybernetics**

Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support*.

### **64 Numerical Analysis**

Includes iteration, difference equations, and numerical approximation.

### **65 Statistics and Probability**

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

### **66 Systems Analysis**

Includes mathematical modeling; network analysis; and operations research.

### **67 Theoretical Mathematics**

Includes topology and number theory.

## Subject Categories of the Division H. Physics

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### 70 Physics (General)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography*; for geophysics, astrophysics or solar physics see *46 Geophysics*, *90 Astrophysics*, or *92 Solar Physics*.

### 71 Acoustics

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution*.

### 72 Atomic and Molecular Physics

Includes atomic structure, electron properties, and molecular spectra.

### 73 Nuclear and High-Energy Physics

Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*.

### 74 Optics

Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers*.

### 75 Plasma Physics

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

### 76 Solid-State Physics

Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

### 77 Thermodynamics and Statistical Physics

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer*.

## Subject Categories of the Division I. Social Sciences

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### **80 Social Sciences (General)**

Includes educational matters.

### **81 Administration and Management**

Includes management planning and research.

### **82 Documentation and Information Science**

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software*.

### **83 Economics and Cost Analysis**

Includes cost effectiveness studies.

### **84 Law, Political Science and Space Policy**

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

### **85 Urban Technology and Transportation**

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety*, *16 Space Transportation*, and *44 Energy Production and Conversion*.

## Subject Categories of the Division J. Space Sciences

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### **88    Space Sciences (General)**

### **89    Astronomy**

Includes radio, gamma-ray, and infrared astronomy; and astrometry.

### **90    Astrophysics**

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics*.

### **91    Lunar and Planetary Exploration**

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

### **92    Solar Physics**

Includes solar activity, solar flares, solar radiation and sunspots. For related information see also *93 Space Radiation*.

### **93    Space Radiation**

Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

## Subject Categories of the Division K. General

Select a category to view the collection of records cited. If the link is broken, there are no records to view.

### 99 General

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.



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# Typical Report Citation and Abstract

- ❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
- ❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
- ❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
- ❹ Mar. 1996; 130p; In English
- ❺ Contract(s)/Grant(s): RTOP 505-68-70-04
- ❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
- ❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
- ❽ Author
- ❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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VOLUME 37, JANUARY 18, 1999

## 01 AERONAUTICS (GENERAL)

**19990008744** National Aerospace Lab., Tokyo, Japan

**Proceedings of the NAL Symposium on Aircraft Computation Aerodynamics**

Feb. 1998; 362p; In Japanese; In English; 15th; Aircraft Computation Aerodynamics, 12-13 Jun. 1997, Tokyo, Japan; Original contains color illustrations

Report No.(s): PB99-108979; NAL-SP-37; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Partial Contents: CFD code developments and validations at ONEA for helicopter applications; Inverse Design Method for Wing of Supersonic Transport; Study on Transonic Flutter Characteristics of an Arrow Wing Configuration; Aerodynamic Analysis of Helicopter Rotor by Coupling of CFD and Trim Calculation Advanced Technology Institute of Commuter-helicopter; A Numerical Simulation of Flow around Rotor Blades using Overlapped Grid Advanced Technology Institute of Commuter-helicopter; and Thin Body Treatment on Unstructured, Cartesian Grid.

NTIS

*Aerodynamic Characteristics; Aerodynamic Configurations; Helicopters; Computational Fluid Dynamics; Design Analysis; Transonic Flutter; Conferences; Flutter Analysis; Aircraft Structures; Numerical Flow Visualization*

**19990008836** National Aerospace Lab., Tokyo, Japan

**Estimation of Aerodynamic Derivatives of B-65 Queen Air by the Equation Error Method**

Masui, K., National Aerospace Lab., Japan; Tsukano, Y., National Aerospace Lab., Japan; Apr. 1997; 56p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108961; NAL-TR-1324; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The longitudinal aerodynamic derivatives of a B-65 were estimated directly from the time histories of several maneuvers by two types of equation error method: the conventional least squares (LS) method and the total least squares (TLS) method. The estimated results were compared with those of the frequency response method. The LS and TLS methods can greatly reduce the time for flight tests without a special device to generate a specific shape of input.

NTIS

*Aerodynamics; Errors; Flight Tests; Error Analysis*

**19990008837** National Aerospace Lab., Tokyo, Japan

**Aerodynamic Characteristics of Hypersonic Flight Experiment (HYFLEX) Vehicle**

Dec. 1997; 108p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108953; NAL-TR-1334; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The Hypersonic Flight Experiment (HYFLEX) vehicle successfully performed a hypersonic lifting flight. The vehicle was developed to establish the basic technologies necessary for an unmanned shuttle vehicle. In this report, the primary aerodynamic characteristics derived from analysis of the flight data are presented. They are aerodynamic force coefficients, longitudinal trim characteristics, stability and control derivatives, elevator hinge moment coefficient, and surface pressure distribution. The flight results are compared with the preflight predictions based on wind tunnel tests and CFD calculations. The purpose of the comparison is to evaluate the validity of the prediction methods including the development of aerodynamic uncertainties in the vehicle

design process. The flight results agreed well with the predictions. This shows that the prediction methods are generally valid for the design of a lifting reentry vehicle with a high angle of attack. On the other hand, some differences between the flight results and the predictions were found in axial force coefficient, elevon trim deflection, and RCS gas-jet interaction. The causes of these are also discussed in this report.

NTIS

*Hypersonic Vehicles; Hypersonic Flight; Aerodynamic Configurations; Computational Fluid Dynamics; Wind Tunnel Tests; Aerodynamic Balance*

**19990008871** NASA Langley Research Center, Hampton, VA USA

**Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 390**

Dec. 25, 1998; 54p; In English

Report No.(s): NASA/SP-1998-7037/SUPPL390; NAS 1.21:7037/SUPPL390; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database.

Author

*Aeronautical Engineering; Bibliographies*

## 02

### AERODYNAMICS

*Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also 34 Fluid Mechanics and Heat Transfer.*

**19990008829** NASA Langley Research Center, Hampton, VA USA

**X-33 Metallic TPS Tests in NASA-LaRC High Temperature Tunnel**

Bouslog, Stanley A., Goodrich (B. F.) Aerospace, USA; Moore, Brad, Goodrich (B. F.) Aerospace, USA; Scanlon, Ron J., Goodrich (B. F.) Aerospace, USA; Sawyer, James Wayne, NASA Langley Research Center, USA; 1998; 7p; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NCC8-115; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Conclusions The first series of metallic TPS tests in the NASA-LaRC Mach 7 High Temperature Tunnel has been completed. Additional testing is in progress and shall provide data for off-design configurations for the metallic TPS. The available data are being analyzed and being used to correlate analytical models to be used for X-33 flight design analysis. The final paper shall present additional data from these tests and comparisons between the data and analytical predictions.

Author

*Wind Tunnel Tests; Design Analysis; X-33 Reusable Launch Vehicle*

**19990008832** NASA Lewis Research Center, Cleveland, OH USA

**Tone Noise and Nearfield Pressure Produced by Jet-Cavity Interaction**

Raman, Ganesh, DYNACS Engineering Co., Inc., USA; Envia, Edmane, NASA Lewis Research Center, USA; Bencic, Timothy J., NASA Lewis Research Center, USA; Nov. 1998; 32p; In English; 37th; Aerospace Sciences Meeting and Exhibit, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS3-27186; RTOP 522-31-23

Report No.(s): NASA/TM-1998-208836; NAS 1.16:208836; AIAA Paper 99-0604; E-11381; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Cavity flow resonance can cause numerous problems in aerospace applications. While our long-term goal is to understand cavity flows well enough to devise effective cavity resonance suppression techniques, this paper describes a fundamental study of resonant tones produced by jet-cavity interaction at subsonic and supersonic speeds. Our specific jet-cavity configuration can also be used as a test bed for evaluating active and passive flow resonance control concepts. Two significant findings emerge from this study. 1) Originally, we expected that tones produced by jet-cavity interaction would resemble cavity tones or jet tones or would involve some simple combinations of each. The experimental data do not support these expectations; instead, the jet cavity interaction produce a unique set of tones. We propose simple yet and physically insightful correlations for these tones. Although the pressure patterns on the cavity floor display very complex variations with the Mach number for a length/depth = 8 cavity, the tones correspond to the acoustic modes of the cavity-independent of flow. For a length/ depth = 3 cavity, however, a surprise emerges: the pressure patterns on the cavity floor are not so complex but the tones depend significantly on the flow. Additionally,

we examine the role of external feedback unique to jet-cavity interaction. 2) Previous research led us to expect that traditional classifications (open, transitional, or closed) for cavities in an infinite flight stream would be insensitive to small changes in Mach number and would depend primarily on cavity length/depth ratios. Use of the novel high resolution photoluminescent pressure sensitive paint shows that the classifications are actually quite sensitive to jet Mach number for a length/depth = 8 cavity. However, these classifications provide no guidance whatsoever for tone amplitude or frequency. Detailed experimental data and insights presented here will assist researchers who are performing numerical simulations of jet-cavity flows as a first step toward devising resonance suppression methods.

Author

*Acoustic Properties; Aerospace Engineering; Cavities; Cavity Flow; Cavity Resonators; Control Theory; Photoluminescence; Subsonic Speed; Supersonic Speed*

**19990009046** NASA Langley Research Center, Hampton, VA USA

**Overview of Sensitivity Analysis and Shape Optimization for Complex Aerodynamic Configurations**

Newman, Perry A., NASA Langley Research Center, USA; Newman, James C., III, Mississippi State Univ., USA; Barnwell, Richard W., Virginia Consortium for Engineering and Science, USA; Taylor, Arthur C., III, Old Dominion Univ., USA; Hou, Gene J.-W., Old Dominion Univ., USA; Jun. 1998; 24p; In English

Contract(s)/Grant(s): NAG1-1265; NGT5-1247; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a brief overview of some of the more recent advances in steady aerodynamic shape-design sensitivity analysis and optimization, based on advanced computational fluid dynamics. The focus here is on those methods particularly well-suited to the study of geometrically complex configurations and their potentially complex associated flow physics. When nonlinear state equations are considered in the optimization process, difficulties are found in the application of sensitivity analysis. Some techniques for circumventing such difficulties are currently being explored and are included here. Attention is directed to methods that utilize automatic differentiation to obtain aerodynamic sensitivity derivatives for both complex configurations and complex flow physics. Various examples of shape-design sensitivity analysis for unstructured-grid computational fluid dynamics algorithms are demonstrated for different formulations of the sensitivity equations. Finally, the use of advanced, unstructured-grid computational fluid dynamics in multidisciplinary analyses and multidisciplinary sensitivity analyses within future optimization processes is recommended and encouraged.

Author

*Aerodynamic Configurations; Computational Fluid Dynamics; Design Analysis; Fluid Dynamics; Unstructured Grids (Mathematics)*

### 03

## AIR TRANSPORTATION AND SAFETY

*Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also 16 Space Transportation and 85 Urban Technology and Transportation.*

**19990008639** Federal Aviation Administration, Technical Center, Atlantic City, NJ USA

**Cargo Compartment Fire Protection in Large Commercial Transport Aircraft**

Blake, David, Federal Aviation Administration, USA; Marker, Timothy, Federal Aviation Administration, USA; Hill, Richard, Federal Aviation Administration, USA; Reinhardt, John, Federal Aviation Administration, USA; Sarkos, Constantine, Federal Aviation Administration, USA; Jul. 1998; 25p; In English

Report No.(s): AD-A355109; DOT/FAA/AR-TN98/32; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes recent research by the Federal Aviation Administration (FAA) related to cargo compartment fire protection in large transport aircraft. A gaseous hydrofluorocarbon, HFC-125, was compared to Halon 1301 in terms of fire suppression effectiveness and agent decomposition levels in the cargo compartment and passenger cabin during full-scale tests involving a bulk-loaded cargo fire. Also, a zoned water mist system was designed and evaluated against a bulk-loaded cargo fire. An exploding aerosol can simulator is being developed to provide a repeatable fire threat for evaluation of new halon replacement agents. The potential severity of an exploding aerosol can inside a cargo compartment and the effectiveness of Halon 1301 inserting was demonstrated. Tests were also conducted to determine the effectiveness of Halon 1301 against a cargo fire involving oxygen canisters. Finally, HFC-125 was evaluated for use as a simulant for Halon 1301 during cargo compartment approval testing to demonstrate compliance with applicable FAA regulations.

DTIC

*Research; Cargo; Commercial Aircraft; Fire Prevention; Safety; Transport Aircraft; Threat Evaluation*

**19990008869** Air Force Inst. of Tech., School of Logistics and Acquisition Management, Wright-Patterson AFB, OH USA

**The Newest Seamless Airlifter: The C-130J-30**

Haven, Douglas L.; Jun. 1998; 53p; In English

Report No.(s): AD-A355606; AFIT/GMO/LAL/98J-8; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The end of the Cold War has had a dramatic effect on America's national security strategy. As the peace dividend continues to yield defense cuts and force reductions throughout the world, we have moved from a forward presence force to a force projection force. Airlift is vital as a first response to any action that requires an American presence. Whether it involves airlifting supplies and personnel into Bosnia in support of IFOR or enforcing sanctions on Iraq, adherence to AMC's Core Competency of Global Reach will continue to place demands on our airlift resources. This demand must be met with a well thought-out employment strategy for all of AMC's airlift assets. The harsh reality is that in the future our airlift assets will experience shortfalls in capability, creating challenges for any transportation system we build. These challenges will force us to develop innovative ways to employ these assets if we hope to meet the demands of projecting those forces anywhere in the world. One airlift asset that will expand our employment options is the next generation Hercules, the C-130J-30. The J-30 is destined to become a part of the airlift picture in the near future and evaluations are under way on how to best utilize it. Should the USAF employ it purely in its traditional intra-theater role, or expand it into the intertheater role? This paper looks at the difference between these roles, examines the traditional role of the C-130, and how this has shaped the way we do business today.

DTIC

*C-130 Aircraft; Rescue Operations; Air Transportation*

## 04

### AIRCRAFT COMMUNICATIONS AND NAVIGATION

*Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 17 Space Communications, Spacecraft Communications, Command and Tracking and 32 Communications and Radar.*

**19990008576** NASA Pasadena Office, CA USA

**Robust Real-Time Wide-Area Differential GPS Navigation**

Yunck, Thomas P., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Bertiger, William I., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Lichten, Stephen M., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Mannucci, Anthony J., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Muellerschoen, Ronald J., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Wu, Sien-Chong, Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Oct. 27, 1998; 9p; In English

Patent Info.: Filed 29 Mar. 1996; NASA-Case-NPO-19625-1-CU; US-Patent-5,828,336; US-Patent-Appl-SN-628566; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention provides a method and a device for providing superior differential GPS positioning data. The system includes a group of GPS receiving ground stations covering a wide area of the Earth's surface. Unlike other differential GPS systems wherein the known position of each ground station is used to geometrically compute an ephemeris for each GPS satellite, the present system utilizes real-time computation of satellite orbits based on GPS data received from fixed ground stations through a Kalman-type filter/smoothing whose output adjusts a real-time orbital model. The orbital model produces and outputs orbital corrections allowing satellite ephemerides to be known with considerable greater accuracy than from the GPS system broadcasts. The modeled orbits are propagated ahead in time and differenced with actual pseudorange data to compute clock offsets at rapid intervals to compensate for SA clock dither. The orbital and clock calculations are based on dual frequency GPS data which allow computation of estimated signal delay at each ionospheric point. These delay data are used in real-time to construct and update an ionospheric shell map of total electron content which is output as part of the orbital correction data, thereby allowing single frequency users to estimate ionospheric delay with an accuracy approaching that of dual frequency users.

Official Gazette of the U.S. Patent and Trademark Office

*Global Positioning System; Kalman Filters; Satellite Orbits; Real Time Operation; Navigation Satellites*

**19990009091** National Aerospace Lab., Tokyo, Japan

**Development of a Laser Tracker and Its Evaluation by Flight Testing**

Ono, T., National Aerospace Lab., Japan; Okada, N., National Aerospace Lab., Japan; Inagaki, T., National Aerospace Lab., Japan; Inokuchi, H., National Aerospace Lab., Japan; Harigae, M., National Aerospace Lab., Japan; Jul. 1998; 38p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108870; NAL-TR-1331; Copyright Waived; Avail: Issuing Activity (Nat'l Technical Information Service (NTIS)), Microfiche

Research is being conducted on flight tests for approach and landing navigation using the NAL Do-228 research airplane and the unmanned vehicle ALFLEX under a joint research project with NAL and NASDA. On these flights, an evaluation of the flight path and navigation sensors was required. The laser tracker was developed for this purpose. This paper outlines the development of the laser tracker and its evaluation based on flight test results. For the accuracy evaluation, laser tracker and its evaluation based on flight test results. For the accuracy evaluation, laser tracker data were compared with kinematic GPS data using on onboard GPS receiver and a ground station GPS receiver. The laser tracker was found to have the required accuracy.

NTIS

*Lasers; Flight Tests; Navigation; Automatic Landing Control; Global Positioning System; Tracking (Position)*

**05**

**AIRCRAFT DESIGN, TESTING AND PERFORMANCE**

*Includes aircraft simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Urban Technology and Transportation.*

**19990008563** Advisory Group for Aerospace Research and Development, Flight Vehicle Integration Panel, Neuilly-Sur-Seine, France

**Enhancement of Aircraft Ground Handling Simulation Capability *L'Amelioration des Moyens de Simulation des Manoeuvres au Sol des Aeronefs***

Barnes, A. G., Advisory Group for Aerospace Research and Development, France; Yager, T. J., NASA Langley Research Center, USA; Aug. 1998; 88p; In English

Report No.(s): AGARD-AG-333; AGARDograph-333; ISBN 92-836-1066-0; Copyright Waived; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report is a guide to methods of representing in a flight simulator, the stability and control of an aircraft on the ground. It updates an earlier publication, AGARDograph 285, in the light of simulation technology improvements over a ten year period. Emphasis is placed on the modeling of the vehicle dynamics, and on the modeling of the tire forces generated by the runway surface. Areas are identified where some current simulators are deficient. The different needs of pilot-in-the-loop and non-real-time simulations are discussed, and topics for further research are identified.

Author

*Flight Simulators; Ground Handling; Computerized Simulation; Mathematical Models; Pilot Support Systems; Flight Simulation*

**19990008588** NASA Ames Research Center, Moffett Field, CA USA

**Tip Fence for Reduction of Lift-Generated Airframe Noise**

Ross, James C., Inventor, NASA Ames Research Center, USA; Storms, Bruce L., Inventor, NASA Ames Research Center, USA; Apr. 14, 1998; 10p; In English

Patent Info.: Filed 8 Jun. 1995; NASA-Case-ARC-14009-1-LE; US-Patent-5,738,298; US-Patent-Appl-SN-482459; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention is directed toward a unique lift-generated noise reduction apparatus. This apparatus includes a plurality of tip fences that are secured to the trailing and leading assemblies of the high-lift system, as close as possible to the discontinuities where the vortices are most likely to form. In one embodiment, these tip fences are secured to some or all of the outboard and inboard tips of the wing slats and flaps. The tip fence includes a generally flat, or an aerodynamically shaped plate or device that could be formed of almost any rigid material, such as metal, wood, plastic, fiber glass, aluminum, etc. In a preferred embodiment, the tip fences extend below and perpendicularly to flaps and the slats to which they are attached, such that these tip fences are aligned with the nominal free stream velocity of the aircraft. In addition to reducing airframe noise, the tip fence tends to decrease drag and to increase lift, thus improving the overall aerodynamic performance of the aircraft. Another advantage presented by the tip fence lies in the simplicity of its design, its elegance, and its ready ability to fit on the wing components, such as the flaps



and the slats. Furthermore, it does not require non-standard materials or fabrication techniques, and it can be readily, easily and inexpensively retrofitted on most of the existing aircraft, with minimal design changes.

Official Gazette of the U.S. Patent and Trademark Office

*Aircraft Structures; Aerodynamic Noise; Aerodynamic Configurations; Aircraft Noise; Noise Reduction; Aircraft Design*

**19990008654** NASA Lewis Research Center, Cleveland, OH USA

**Design, Installation, and Evaluation of an Altitude Test Facility Modification**

Abdelwahab, Mahmood, NASA Lewis Research Center, USA; Moore, Allan S., NASA Lewis Research Center, USA; Soeder, Ronald H., NASA Lewis Research Center, USA; Sorge, Richard N., NASA Lewis Research Center, USA; DelRosio, Richard, NASA Lewis Research Center, USA; Dicki, Dennis J., DYNACS Engineering Co., Inc., USA; Nov. 1998; 46p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS3-27186; RTOP 523-91-13

Report No.(s): NASA /TM-1997-206323; E-11016; NAS 1.15:206323; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the design, installation, and evaluation of the turbine engine altitude test facility modifications. This facility is located in test cell 4 (PSL4) at the Lewis Research Center Propulsion Systems Laboratory (PSL). The modifications were made to enhance the test cell capability for engine inlet air supply conditions from a prior maximum of 55 psia and 600 F to a new rating of 165 psia and 1200 F. The maximum conditions reached during the interim evaluation were 129 psia and 844 F at an airflow of 159 lb/sec. Also, the modified facility airflow quality as defined by the flow characteristics at a typical gas turbine engine inlet were investigated and were adequate.

Author

*Engine Tests; Altitude Tests; Engine Inlets; Air Flow; Test Facilities; Test Ranges*

**19990008707** Boeing Co., Rotorcraft Div., Philadelphia, PA USA

**Advanced Maintenance Aid Concepts Final Report, May 1997 - Nov. 1998**

Cushman, Robert; Sawaya, John; Beggs, Robert; Oct. 15, 1998; 40p; In English

Contract(s)/Grant(s): DAAJ09-95-G-0018

Report No.(s): AD-A355036; USAAMCOM-TR-98-D-25; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Advanced Maintenance Aid Concepts (AMAC) Final Report summarizes the effort to analyze, design and prototype a next-generation portable maintenance aid for the CH-47 Chinook helicopter. The AMAC Demonstrator supports both the traditional phase maintenance system used today as well as multiple, flexible maintenance management schemes responsive to operation within a digital aviation logistics (DAL) environment.

DTIC

*Prototypes; CH-47 Helicopter; Digital Systems*

**19990008713** Federal Aviation Administration, Office of Aviation Research, Washington, DC USA

**Effects of Concentrated Hydrochloric Acid Spills on Aircraft Aluminum Skin**

Speitel, Louise C.; Jul. 1998; 13p; In English

Report No.(s): AD-A355072; DOT/FAA/AR-TN-97/108; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document describes the tests conducted to evaluate the effects of a spill of a strong corrosive acid such as hydrochloric acid (HCl) on aircraft interior skin and to determine the time required for a spill of Department of Transportation (DOT) allowable volumes and concentrations to cause catastrophic failure. Test data indicate that the epoxy coated interior aluminum skin is resistant to acid attack. The acid reacted vigorously with scratched skin surfaces, creating a wide hole in the skin along the scratch line. Test data also indicate that a spill of concentrated HCl can eat completely through the rivets and ribs and may result in a significant loss of structural rib strength.

DTIC

*Aircraft Compartments; Aluminum; Coatings; Corrosion; Epoxy Resins*

**19990008736** Department of Transportation, John A. Volpe National Transportation Systems Center, Cambridge, MA USA

**Development of Noise Dose/Visitor Response Relationships for the National Parks Overflight Rule: Bryce Canyon National Park Study Final Report, May 1997 - Jul. 1998**

Fleming, Gregg G.; Roof, Christopher J.; Rapoza, Amanda S.; Read, David R.; Webster, Joel C.; Jul. 1998; 258p; In English

Contract(s)/Grant(s): PA865/AB012

Report No.(s): AD-A355018; DOT-VNTSC-FAA-98-6; FAA-AEE-98-01; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The Federal Aviation Administration's Office of Environment and Energy, with the assistance of the Acoustics Facility at the USA Department of Transportation's John A. Volpe National Transportation Systems Center is conducting research in support of the National Parks Overflight Rule (National Rule). The foundation of the research program for the National Rule is the performance of noise dose/visitor response (dose-response) studies in several National Parks. This document summarizes the results of a dose-response study conducted along two separate segments of a frontcountry, short-hike trail at Bryce Canyon National Park during the period August 19 through 27, 1997.

DTIC

*Noise Pollution; Acoustics; Dosage; Aircraft Noise*

**19990008842** Naval Postgraduate School, Monterey, CA USA

**An Evaluation of Markov Chain Modeling for F/A-18 Aircraft Readiness**

Ackart, Leigh P.; Sep. 1998; 57p; In English

Report No.(s): AD-A355761; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

During its 1998 deployment the USS INDEPENDENCE (CV 62) and Carrier Air Wing Five operated under the control of Commander, Task Force 50 (CTF-50). To balance resources and readiness, CTF-50 asked the following question: "How many days can the USS INDEPENDENCE go without "off ship" logistics support before the number of Mission Capable aircraft can be expected to fall below Chief of Naval Operations readiness goals?" This thesis develops a Markov chain model to answer this question. Explanatory variables for this model include sorties flown, cannibalization rate and frequency of "off ship" logistics support. Using data from INDEPENDENCE, this thesis analyzes aviation readiness by estimating the number of F/A-18 aircraft capable of performing at least one of its intended missions. Both non-linear Markov models and Generalized Linear Models are employed to estimate the effect of the operating environment on the number of mission capable aircraft available. The analysis demonstrates how the Markov approach captures the cyclic nature of aircraft operations and maintenance. Specifically, it is shown that INDEPENDENCE can expect to operate five to eight days without "off ship" logistics support before F/A-18 MC rates fall below CNO readiness goals. Recommendations for further studies are included.

DTIC

*Aircraft Carriers; Markov Processes; F-18 Aircraft; Markov Chains; Flight Operations*

**19990008962** Virginia Univ., Dept. of Civil Engineering, Charlottesville, VA USA

**Void Nucleation and Growth in Nonlinear Solids Final Report, 9 Jan. 1994 - 30 Aug. 1998**

Horgan, Cornelius O.; Aug. 30, 1998; 15p; In English

Contract(s)/Grant(s): F49620-94-1-0349; AF Proj. 2304

Report No.(s): AD-A355829; UVA/525800/CE99/102; AFRL-SR-BL-TR-98-0696; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Thin-walled structures of interest to the U. S. Air Force, such as aircraft fuselages, rocket casings, helicopter blades, and containment vessels, are often constructed of layers of anisotropic, filament or fiber-reinforced materials which must be designed to remain elastic. Our research has been concerned with load diffusion in such structures. An understanding of the fundamental mechanisms of load diffusion in composite subcomponents is essential in developing primary composite structures. Analytical models of load diffusion behavior are extremely valuable in building an intuitive base for developing refined modeling strategies and assessing results from finite element analyses. The decay behavior of stresses and other field quantities provides a significant aid towards this process. Our results are also useful for structural tailoring.

DTIC

*Composite Structures; Diffusion; Fiber Composites; Finite Element Method; Helicopters; Loads (Forces); Mathematical Models; Thin Walls*

**19990009070** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

**Analysis of the Interaction Effect for Bonded Repairs**

Callinan, R. J.; Rose, L. R.; Sanderson, S.; Aug. 1998; 26p; In English

Report No.(s): AD-A355822; DSTO-TR-0715; DODA-AR-010-621; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the increasing use of bonded repairs to restore the structural integrity of ageing aircraft the question arises as to the interaction effects when repairs are located close together. Using the Finite Element (F.E.) method a study has been carried out for the interaction between two idealised circular repairs. The interaction involves the increase of the sheet stress just outside the patch.

It has been found that the tandem orientation, with respect to the applied load, is the most severe configuration. In this case, for most practical repairs, the interaction may result in increases of the sheet stress by 40% for very close separation distances. It has also been found that certain combinations of bi-axial load can also significantly influence the interaction effect.

DTIC

*Axial Loads; Finite Element Method; Structural Failure*

## 07

### AIRCRAFT PROPULSION AND POWER

*Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.*

**19990008859** NASA Lewis Research Center, Cleveland, OH USA

#### **Model-Based Fault Diagnosis for Turboshaft Engines**

Green, Michael D., Florida Atlantic Univ., USA; Duyar, Ahmet, Florida Atlantic Univ., USA; Litt, Jonathan S., NASA Lewis Research Center, USA; Nov. 1998; 10p; In English; Fault Detection, Supervision and Safety for Technical Processes - SAFEPRO-CESS '97, 26-28 Aug. 1997, Kingston Upon Hull, UK; Sponsored by International Federation of Automatic Control, Germany Contract(s)/Grant(s): RTOP 505-62-50; DA Proj. 111-61102-AH-45

Report No.(s): NASA/TM-1998-208825; NAS 1.15:208825; ARL-TR-1447; E-11433; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Tests are described which, when used to augment the existing periodic maintenance and pre-flight checks of T700 engines, can greatly improve the chances of uncovering a problem compared to the current practice. These test signals can be used to expose and differentiate between faults in various components by comparing the responses of particular engine variables to the expected. The responses can be processed on-line in a variety of ways which have been shown to reveal and identify faults. The combination of specific test signals and on-line processing methods provides an ad hoc approach to the isolation of faults which might not otherwise be detected during pre-flight checkout.

Author

*Turbine Engines; Turboshfts; Error Analysis; Systematic Errors*

**19990008889** NASA Ames Research Center, Moffett Field, CA USA

#### **Neural Net-Based Redesign of Transonic Turbines for Improved Unsteady Aerodynamic Performance**

Madavan, Nateri K., NASA Ames Research Center, USA; Rai, Man Mohan, NASA Ames Research Center, USA; Huber, Frank W., Riverbed Design Services, USA; Nov. 1998; 20p; In English; 35th; Propulsion, 20-24 Jun. 1999, Los Angeles, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 519-40-12

Report No.(s): NASA/TM-1998-208754; A-9900398; NAS 1.15:208754; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A recently developed neural net-based aerodynamic design procedure is used in the redesign of a transonic turbine stage to improve its unsteady aerodynamic performance. The redesign procedure used incorporates the advantages of both traditional response surface methodology (RSM) and neural networks by employing a strategy called parameter-based partitioning of the design space. Starting from the reference design, a sequence of response surfaces based on both neural networks and polynomial fits are constructed to traverse the design space in search of an optimal solution that exhibits improved unsteady performance. The procedure combines the power of neural networks and the economy of low-order polynomials (in terms of number of simulations required and network training requirements). A time-accurate, two-dimensional, Navier-Stokes solver is used to evaluate the various intermediate designs and provide inputs to the optimization procedure. The optimization procedure yields a modified design that improves the aerodynamic performance through small changes to the reference design geometry. The computed results demonstrate the capabilities of the neural net-based design procedure, and also show the tremendous advantages that can be gained by including high-fidelity unsteady simulations that capture the relevant flow physics in the design optimization process.

Author

*Supersonic Turbines; Navier-Stokes Equation; Fluid Dynamics; Design Analysis; Aerodynamic Characteristics*



**19990008911** Rolls-Royce Ltd., Colne, Fan Systems, Lancashire, UK

**Establishing Best Practice in the Design and Manufacture of Hollow Titanium Fan Blades**

Fitzpatrick, G. A., Rolls-Royce Ltd., Colne, UK; Lloyd, A. D., Rolls-Royce Ltd., UK; Nov. 1998; 4p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

Rolls-Royce has designed and developed highly efficient lightweight titanium fans for civil engine applications in the thrust range 22000 lbs to over 100000 lbs. These wide chord fan designs are hollow and snubberless, and their fabrication has required the development of joining and forming technologies as well as a thorough understanding of material behaviour. The first generation wide chord fan design is a honeycomb-cored fabrication. It entered service via the RB211-535E4 aeroengine in 1984. This technology has subsequently been applied to the I4E V2500 engine and the RB211-524G/H powerplants. Technological research continued into the 1990's to develop an alternative lighter fan concept for larger thrust engines. This resulted in the second generation wide chord fan design which exploits solid-state diffusion bonding for joining the fabrication and superplastic forming for the development of the internal core. As well as reducing component weight, there was also a need to economise product cost and to shorten the design-make process. Rolls-Royce, therefore, launched its Fan Key System to electronically integrate engineering and manufacturing activities whilst, at the same time, incorporating process modelling for the optimisation of the key manufacturing technologies. These latest advances have been applied to the Trent 700 engine which entered service in 1995 and, subsequently, to the Trent 800 powerplant. Their flexibility is now allowing the development of the swept fan concept for higher thrust versions of the Trent 800 engine, and the application of these technologies to appropriate military projects.

Author

*Process Control (Industry); Computer Aided Manufacturing; Fan Blades; Fabrication; Titanium; Superplastic Forming; Metal Bonding*

**19990008961** NASA Lewis Research Center, Cleveland, OH USA

**A Simplified Model for the Investigation of Acoustically Driven Combustion Instabilities**

Paxson, Daniel E., NASA Lewis Research Center, USA; Quinn, D. Dane, Akron Univ., USA; Nov. 1998; 14p; In English; 34th; Joint Propulsion, 12-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA Contract(s)/Grant(s): RTOP 523-26-13

Report No.(s): NASA/TM-1998-208488; NAS 1.15:208488; AIAA Paper 98-3764; E-11267; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A simplified one-dimensional model of reactive flow is presented which captures features of aeropropulsion systems, including acoustically driven combustion instabilities. Although the resulting partial differential equations are one dimensional, they qualitatively describe observed phenomena, including, resonant frequencies and the admission of both steady and unsteady behavior. A number of simulations are shown which exhibit both steady and unsteady behavior, including flame migration and thermo acoustic instabilities. Finally, we present examples of unsteady flow resulting from fuel modulation.

Author

*Acoustic Instability; Combustion; Simulation; Unsteady Flow*

**08**

**AIRCRAFT STABILITY AND CONTROL**

*Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also 05 Aircraft Design, Testing and Performance.*

**19990008637** Naval Air Systems Command, Structures Div., Patuxent, MD USA

**A Laboratory Development and Networking Concept for Naval Aviation**

Schibler, William H., Naval Air Systems Command, USA; Katz, Rodney S., Pacific-Sierra Research Corp., USA; Seals, Kathy, Naval Air Systems Command, USA; Jan. 1998; 22p; In English

Report No.(s): AD-A355242; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a concept for laboratory utilization and networking in support of avionics systems development and integration for Naval Aviation. The Naval development centers for air systems have a number of separate laboratory facilities that deal with the many facets of avionics systems in Navy airborne platforms. The laboratories associated in developing and implementing this concept are those located at the Naval Air Warfare Centers (NAWCs) at Patuxent River MD, China Lake CA and Point Mugu CA. The purpose of exploring and then implementing this concept is to ensure that the Navy makes maximum use of the laboratory resources available, and through networking, provides a capability for multiple center participation in shared program developments. The effort underway is embodied in two elements: Modular Avionics Integration Laboratory (MAIL) and

Modular Avionics Integration Network (MAIN). The MAIL element is concerned with the identification and networking together, laboratory resources within the confines of a single development center. The MAIN concept is a networking approach for linking the three centers so that intercenter participation can be achieved for broad scope systems development and integration programs. Taken together, the MAIN and MAIL represent a forward step towards implementing a consistent systems engineering based process for avionics systems evaluation, development and integration for the Navy.

DTIC

*Avionics; Computer Networks; Research Facilities; Armed Forces*

**19990009089** National Aerospace Lab., Tokyo, Japan

**Model Following Control Scheme Incorporating Integral Compensator for Multiple Hydraulic Flight Control Systems**

Ogawa, T., National Aerospace Lab., Japan; Oct. 1997; 24p; In Japanese; Portions of this document are not fully legible  
Report No.(s): PB99-108821; NAL-TR-1336; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Mechanical summing of the output of redundant flight control systems into a single axis shows that the output forces do not always act synchronously, because there are the differences of output in respective systems caused by system parameter variations and disturbances. As a result, operation of the systems is never smooth and the servomechanism is subjected to excessive loads. To prevent these problems, we apply a model following control incorporating an integral compensator to the redundant systems. In this control system, steady state errors do not arise if the system parameters vary from their nominal values and constant disturbances. Experimental results were demonstrated by operating three-channel electro-hydraulic servosystems.

NTIS

*Compensators; Hydraulic Control; Flight Control; Hydraulic Equipment*

## 09

### RESEARCH AND SUPPORT FACILITIES (AIR)

*Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also 14 Ground Support Systems and Facilities (Space).*

**19990008840** National Aerospace Lab., Tokyo, Japan

**Sting Supporting System with Controllable Roll Mode**

Kanda, A., National Aerospace Lab., Japan; Ueda, T., National Aerospace Lab., Japan; Sep. 1997; 30p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108904; NAL-TR-1335; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

To address the wing flutter problem, it is important to take into consideration the anti-symmetric mode since it sometimes becomes the most critical mode. For wind tunnel experiments, the authors made a peculiar supporting system that allows motion of the model about its roll axis. This system also has a function that can constrain rolling motion to stop anti-symmetric mode flutter. Flutter experiments were conducted in TWT (Transonic Wind Tunnel) at NAL. It was confirmed that anti-symmetric mode flutter occurred at the flutter boundary and that the supporting system worked successfully. Moreover, flutter characteristics were analytically examined by DPM (Doublet Point Method).

NTIS

*Roll; Flutter Analysis; Transonic Wind Tunnels; Transonic Flutter*

**19990008857** NASA Lewis Research Center, Cleveland, OH USA

**Design, Installation, and Evaluation of an Altitude Test Facility Modification**

Abdelwahad, Mahmood, NASA Lewis Research Center, USA; Moore, Allan S., NASA Lewis Research Center, USA; Soeder, Ronald H., NASA Lewis Research Center, USA; Sorge, Richard N., NASA Lewis Research Center, USA; DelRosio, Richard, NASA Lewis Research Center, USA; Dicki, Dennis J., DYNACS Engineering Co., Inc., USA; Nov. 1998; 44p; In English  
Contract(s)/Grant(s): NAS3-27186; RTOP 523-91-13

Report No.(s): NASA/TM-1997-206323; NAS 1.15:206323; E-11016; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the design, installation, and evaluation of the turbine engine altitude test facility modifications. This facility is located in test cell 4 (PSL4) at the Lewis Research Center Propulsion Systems Laboratory (PSL). The modifications were made to enhance the test cell capability for engine inlet air supply conditions from a prior maximum of 55 psia and 600 F

to a new rating of 165 psia and 1200 F. The maximum conditions reached during the interim evaluation were 129 psia and 844 F at an airflow of 159 lb/sec. Also, the modified facility airflow quality as defined by the flow characteristics at a typical gas turbine engine inlet were investigated and were adequate.

Author

*Turbine Engines; Propulsion System Performance; Propulsion System Configurations; Gas Turbine Engines; Flow Characteristics*

**19990008879** Naval Postgraduate School, Monterey, CA USA

**A LabVIEW Based Wind Tunnel Data Acquisition System**

Huff, Michael R.; Sep. 1998; 130p; In English

Report No.(s): AD-A355656; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The NPS Aerolab Low Speed Wind Tunnel located in Halligan Hall of the Navy Postgraduate School has been in operation since 1953. Although the tunnel is well maintained, its data acquisition system has not kept pace with modern technology. An effective but affordable solution for acquiring data was needed. It was determined that a software package known as LabVIEW would provide a low cost, data acquisition solution that will enhance the capabilities of the wind tunnel, while at the same time making it more user friendly to faculty and students. The focus of this thesis is the design of a VI that will collect and plot force and moment data from a six component strain gauge balance and yield real time, non-dimensional, force and moment coefficients in six degrees of freedom. Wind tunnel tests consisting of angle-of-attack sweeps in the NPS Aerolab low-speed wind tunnel were conducted to verify (i) optimized,  $M=6$ , conical-flow waverider data obtained in 1994 using a different data acquisition system. Results of current testing substantiate the LabVIEW code and the validity of the 1994 test data. Analysis of the current wind tunnel test data resolved pitching moment concerns related to the 1994 data.

DTIC

*Data Acquisition; Low Speed Wind Tunnels; Aerodynamic Coefficients; Applications Programs (Computers); Real Time Operation*

## 12

### ASTRONAUTICS (GENERAL)

*For extraterrestrial exploration see 91 Lunar and Planetary Exploration.*

**19990008457** NASA Marshall Space Flight Center, Huntsville, AL USA

**The TSS-1R Mission: Overview and Scientific Context**

Stone, N. H., NASA Marshall Space Flight Center, USA; Bonifazi, C., Italian Space Agency, Italy; Geophysical Research Letters; Feb. 15, 1998; ISSN 0094-8276; Volume 25, No. 4, pp. 409-412; In English

Report No.(s): Paper-97GL02980; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Tethered Satellite System (TSS) program is a binational collaboration between NASA and the Italian Space Agency (ASI) with NASA providing the Shuttle-based deployer and tether and ASI providing a satellite especially designed for tethered deployment. Twelve science investigations were supported by NASA, ASI, or the Air Force Philips Laboratory. The goals of the TSS-1R mission, which was the second flight of the TSS hardware, were to provide unique opportunities to explore (1) certain space plasma-electrodynamic processes-particularly those involved in the generation of ionospheric currents, and (2) the orbital mechanics of a gravity-gradient stabilized system of two satellites linked by a long conducting tether. TSS-1R was launched February 22, 1996 on STS-75 into a 300-km, circular orbit at 28.5 deg. inclination. Satellite flyaway occurred at MET 3/00:27 and a unique data set was obtained over the next 5 hours as the tether was deployed to a length of 19,695 m. At MET 3/05:11, during a day pass, the tether suddenly broke near the top of the deployer boom. The break resulted from a flaw in the tether insulation which allowed the ignition of a strong electrical discharge that melted the tether. The operations that had begun at satellite flyaway, however, allowed significant science to be accomplished.

Author

*Tethered Satellites; Space Plasmas; Ionospheric Currents; Orbital Mechanics*

**19990008764** NASA Marshall Space Flight Center, Huntsville, AL USA

**Orbital Debris Impact Damage to Reusable Launch Vehicles**

Robinson, Jennifer H., NASA Marshall Space Flight Center, USA; 1998; 12p; In English; Hypervelocity Symposium, Nov. 1998, Huntsville, AL, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In an effort by the National Aeronautics and Space Administration (NASA), hypervelocity impact tests were performed on thermal protection systems (TPS) applied on the external surfaces of reusable launch vehicles (RLV) to determine the potential damage from orbital debris impacts. Three TPS types were tested, bonded to composite structures representing RLV fuel tank walls. The three heat shield materials tested were Alumina-Enhanced Thermal Barrier-12 (AETB-12), Flexible Reusable Surface Insulation (FRSI), and Advanced Flexible Reusable Surface Insulation (AFRSI). Using this test data, predictor equations were developed for the entry hole diameters in the three TPS materials, with correlation coefficients ranging from 0.69 to 0.86. Possible methods are proposed for approximating damage occurring at expected orbital impact velocities higher than tested, with references to other published work.

Author

*Orbital Velocity; Impact Damage; Reusable Launch Vehicles; Hypervelocity Impact; Space Debris; Impact Tests*

## 13 ASTRODYNAMICS

*Includes powered and free-flight trajectories; and orbital and launching dynamics.*

**19990009052** Ohio State Univ., Civil and Environmental Engineering, Columbus, OH USA

**The Study of Effects of Time Variations in the Earth's Gravity Field on Geodetic Satellites** *Final Report, 1 Nov. 1997 - 31 Oct. 1998*

Shum, C. K., Ohio State Univ., USA; Nov. 01, 1998; 7p; In English

Contract(s)/Grant(s): NAG5-6697; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The temporal variations in the Earth's gravity field are the consequences of complex interactions between atmosphere, ocean, solid Earth, hydrosphere and cryosphere. The signal ranges from several hours to 18.6 years to geological time scale. The direct and indirect consequences of these variations are manifested in such phenomena as changes in the global sea level and in the global climate pattern. These signals produce observable geodetic satellites. The primary objectives of the proposed effects on near-Earth orbiting investigation include (1) the improved determination of the time-varying gravity field parameters (scale from a few hour to 18.6 year and secular) using long-term satellite laser ranging (SLR) observations to multiple geodetic satellites, and (2) the enhanced understanding of these variations with their associated meteorological and geophysical consequences.

Author

*Gravitational Fields; Geodetic Satellites; Temporal Distribution; Observation; Laser Range Finders; Geophysics; Geochronology; Earth Gravitation*

## 14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

*Includes launch complexes, research and production facilities; ground support equipment; e.g., mobile transporters; and simulators. For related information see also 09 Research and Support Facilities (Air).*

**19990008976** Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA

**Kwajalein Missile Range Modernization and Support of BMDO Testing**

Ince, William J., Massachusetts Inst. of Tech., USA; Potts, Bing, Massachusetts Inst. of Tech., USA; Villeneuve, David, Kwajalein Missile Range, Marshall Islands; Jan. 1998; 10p; In English

Contract(s)/Grant(s): F19628-95-C-0002

Report No.(s): AD-A355748; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Kwajalein Missile Range (KMR) has embarked on a four-year major modernization program in which much of the Range instrumentation will be upgraded. The major benefits to KMR are improved efficiency and reduced cost of operation. High maintenance, unique components will be replaced with commercial off-the-shelf equipment. Sensors are being reconfigured to incorporate common architectures, where practical, resulting in common parts sparing, and reduced maintenance staffing. The new architecture supports a significant degree of automation, enabling instrumentation to be monitored and operated remotely. Sensor control and execution of missions will be from a central location, the Mission Control Center on Kwajalein Island. Much of the telemetry equipment will be consolidated into a new location on Kwajalein. Telemetry and optical assets that remain on outer islands of the Atoll are being upgraded to achieve higher reliability and improved performance. This will either eliminate or drastically reduce the requirement for daily aircraft commuter services to the various equipment sites around the Atoll. The major technical benefits of modernization to the users of KMR are improved sensor capability, flexibility in specifying and satisfying test

needs, and more timely data reduction. The enhancement of KMR's instrumentation and the extension of the Range Safety Center's capability to enable it to handle multiple simultaneous engagements increase the diversity and scope of future testing. KMR is uniquely qualified to support full envelope testing of multi-layer TMD and NMD target engagements.

DTIC

*Telemetry; Range Safety; Position (Location); Missile Ranges; Cost Reduction*

**19990009061** Naval Research Lab., Space Experiment Section, Washington, DC USA

**The Effects of Neutral Gas Release on Vehicle Charging: Experiment and Theory *Interim Report***

Walker, D. N., Naval Research Lab., USA; Amatucci, W. E., Naval Research Lab., USA; Fernsler, R. F., Naval Research Lab., USA; Siefring, C. L., Naval Research Lab., USA; Keskinen, M. J., Naval Research Lab., USA; Oct. 30, 1998; 29p; In English Report No.(s): AD-A355628; NRL/MR/6755-98-8171; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes an experimental and theoretical research effort related to the mitigation of spacecraft charging by Neutral Gas Release (NGR). Laboratory simulations which employ a charged aluminum cylinder containing a neutral gas release valve have verified the effectiveness of NGR as a means of mitigating high voltages under environmental conditions close to the natural space environment. The charging electronics were developed under the Space Experiment Aboard Rockets (SPEAR) program. The experiments were conducted in the large volume Space Physics Simulation Chamber (SPSC) at the Naval Research Laboratory. This Laboratory environment is similar to that encountered by LEO spacecraft, e.g., the Space Station, Shuttle, and high inclination satellites. The basis of the theoretical treatment is a simple Townsend discharge. In addition the nozzle release of neutral gas is modeled and a simple linear spatial dependence of the applied potential is assumed. This basic model produces quite good results when compared to the experiment.

DTIC

*Aerospace Environments; Atmospheric Physics; Low Earth Orbits; Space Stations; Spaceborne Experiments; Spacecraft Charging*

## 15

### LAUNCH VEHICLES AND SPACE VEHICLES

*Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also 20 Spacecraft Propulsion and Power.*

**19990008538** NASA Lewis Research Center, Cleveland, OH USA

**Real-Time Sensor Validation, Signal Reconstruction, and Feature Detection for an RLV Propulsion Testbed**

Jankovsky, Amy L., NASA Lewis Research Center, USA; Fulton, Christopher E., Analox Corp., USA; Binder, Michael P., NYMA, Inc., USA; Maul, William A., III, NYMA, Inc., USA; Meyer, Claudia M., NYMA, Inc., USA; Oct. 1998; 12p; In English Contract(s)/Grant(s): RTOP 242-33-01

Report No.(s): NASA/TM-1998-208807; NAS 1.15:208807; E-11392; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A real-time system for validating sensor health has been developed in support of the reusable launch vehicle program. This system was designed for use in a propulsion testbed as part of an overall effort to improve the safety, diagnostic capability, and cost of operation of the testbed. The sensor validation system was designed and developed at the NASA Lewis Research Center and integrated into a propulsion checkout and control system as part of an industry-NASA partnership, led by Rockwell International for the Marshall Space Flight Center. The system includes modules for sensor validation, signal reconstruction, and feature detection and was designed to maximize portability to other applications. Review of test data from initial integration testing verified real-time operation and showed the system to perform correctly on both hard and soft sensor failure test cases. This paper discusses the design of the sensor validation and supporting modules developed at LeRC and reviews results obtained from initial test cases.

Author

*Systems Health Monitoring; Real Time Operation; Signal Processing; Checkout; Expert Systems; Sensors*

**19990008655** NASA Lewis Research Center, Cleveland, OH USA

**Launch Vehicle Performance With Solid Particle Feed Systems for Atomic Propellants**

Palaszewski, Bryan, NASA Lewis Research Center, USA; Nov. 1998; 27p; In English; 34th; Propulsion, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations Contract(s)/Grant(s): RTOP 260-98-09



Report No.(s): NASA/TM-1998-208498; E-11294; NAS 1.15:208498; AIAA Paper 98-3736; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis of launch vehicle Gross Liftoff Weight (GLOW) using high energy density atomic propellants with solid particle feed systems was conducted. The analyses covered several propellant combinations, including atoms of aluminum (Al), boron (B), carbon (C), and hydrogen (H) stored in a solid cryogenic particle, with a cryogenic liquid as the carrier fluid. Several different weight percents (wt%) for the liquid carrier were investigated and the gross lift off weight (GLOW) of the vehicles using the solid particle feed systems were compared with a conventional O<sub>2</sub>/H<sub>2</sub> propellant vehicle. The potential benefits and effects of feed systems using solid particles in a liquid cryogenic fluid are discussed.

Author

*Cryogenic Rocket Propellants; Feed Systems; Launch Vehicles; Spacecraft Propulsion; Rocket Engines; Slurry Propellants; Propulsion System Performance; Propulsive Efficiency; Gelled Rocket Propellants*

**19990008843** Naval Postgraduate School, Monterey, CA USA

### **Teledesic's Capabilities to Meet Future Department of Defense Wideband Communications Requirements**

Wickline, James O.; Sep. 1998; 169p; In English

Report No.(s): AD-A355766; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Success in modern military operations now depends upon the connectivity provided by communication systems. Space-based communication assets, due to their accessibility, coverage, flexibility, and global reach, are in many cases the only practical means to support transportable and mobile warfighter requirements. Joint Vision 2010's view of future warfighting and its higher, complex operational tempos will demand unprecedented distribution of information, for rapid warfighter interaction, battlefield coordination and joint interoperability. The increasing lethality, mobility and range of weapons, coupled with a smaller and more dispersed force structure, result in significantly increased amounts of three-dimensional battlespace over which an individual force element must maintain awareness and control. The end result is a lethal, deployable military, which is dependent on high-volume information transfers, most of which are graphical, pictorial, or data-intensive in nature. Information, and speed of delivery, are driving the warfighter's demand for higher capacity, wideband satellite communications systems. It is the focus of this research to assist DoD in ascertaining the correct, affordable mix of DoD owned SATCOM and commercial SATCOM that can best meet the warfighter's growing information requirements. The Teledesic Wideband Satellite Communication System is examined for future integration into the DoD MILSATCOM architecture and its military applications. Failure to provide the requisite amounts of communications to the right users when and where required will prevent a full return on the investment in advanced weapons, sensor platforms and combat support systems. Recognizing this, DOD needs to make an investment in Teledesic and other information age throughput technologies.

DTIC

*Satellite Communication; Communication Satellites; Defense Program; Military Operations; Wideband Communication*

## **16**

### **SPACE TRANSPORTATION**

*Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. for related information see also 03 Air Transportation and Safety and 18 Spacecraft Design, Testing and Performance. For space suits see 54 Man/System Technology and Life Support*

**19990008745** NASA Johnson Space Center, Houston, TX USA

### **STS-95 Day 09 Highlights**

Nov. 07, 1998; In English; Videotape: 24 min. 35 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998408700; BRF-1416I; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this ninth day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, spend a good part of their day checking out important spacecraft systems for entry and landing. The commander and pilot begin the flight control system checkout by powering up one auxiliary power unit and evaluating the performance of aerodynamic surfaces and flight controls. The flight crew conducts a reaction control system hot fire, followed by a test of the communications system.

CASI

*Space Transportation System Flights; Space Transportation System; Spacecrews; Flight Control; Control Surfaces; Auxiliary Power Sources*

**19990008748** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 07 Highlights**

Nov. 05, 1998; In English; Videotape: 41 min. 33 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998401600; BRF-1416G; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this seventh day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, again test the Orbiter Space Vision System. OSVS uses special markings on Spartan and the shuttle cargo bay to provide an alignment aid for the arm's operator using shuttle television images. It will be used extensively on the next Space Shuttle flight in December as an aid in using the arm to join together the first two modules of the International Space Station. Specialist John Glenn will complete a daily back-pain questionnaire by as part of a study of how the muscle, intervertebral discs and bone marrow change after exposure to microgravity.

CASI

*International Space Station; Space Transportation System Flights; Space Transportation System; Space Shuttle Orbiters; Spacecrews; Bays (Structural Units)*

**19990008749** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 06 Highlights**

Nov. 04, 1998; In English; Videotape: 12 min. 21 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998401598; BRF-1416F; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this sixth day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, test a device called the Video Guidance Sensor, a component of an automated docking system being prepared for use on the International Space Station. As Discovery closes in on Spartan, the astronauts will use a laser system that provides precise measurements of how far away the shuttle is from a target and how fast it is moving toward or away from the target.

CASI

*International Space Station; Space Transportation System; Space Transportation System Flights; Spacecraft Docking; Astronauts*

**19990008750** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 04 Highlights**

Nov. 01, 1998; In English; Videotape: 30 min. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998401597; BRF-1416D; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this forth day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, are seen performing an evaluation of bone cell activity under microgravity conditions. Glenn then provides blood samples as part of the Protein Turnover Experiment, which is looking at the balance between the building and breakdown of muscle. He also works with the Advanced Organic Separations (ADSEP) experiment, to provides the capability to separate and purify biological materials in microgravity; and with the Microencapsulation Electrostatic Processing System (MEPS), that studies the formation of anti-tumor capsules containing two kinds of drugs.

CASI

*Space Transportation System; Space Transportation System Flights; Spacecrews; Microgravity*

**19990008751** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 05 Highlights**

Nov. 03, 1998; In English; Videotape: 22 min. 1 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998401596; BRF-1416E; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this fifth day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, check the status of components of the Hubble Space Telescope Orbital Systems Test (HOST) payload, which provides an on-orbit test

bed for hardware that will be used during the third Hubble servicing mission. Then Parazynski and Pilot Steve Lindsey set up some of the tools that will be used during the rendezvous and subsequent capture and reberthing of the Spartan satellite.

CASI

*Space Transportation System; Space Transportation System Flights; Spacecrews; Crew Observation Stations; Crew Experiment Stations*

**19990008752** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 03 Highlights**

Oct. 31, 1998; In English; Videotape: 25 min. 10 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998397355; BRF-1416C; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this third day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, are seen checking out equipment that will be used for the deployment of the Spartan, a small, Shuttle-launched and retrieved satellite, whose mission is to study the Sun.

CASI

*Space Transportation System; Space Transportation System Flights; Spacecraft Launching; Spacecrews*

**19990008754** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 08 Highlights**

Nov. 06, 1998; In English; Videotape: 38 min. 56 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998408702; BRF-1416H; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this eighth day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, continue to perform microgravity experiments. Specialist John Glenn completes a back-pain questionnaire as part of a study of how the muscle, intervertebral discs and bone marrow change due to microgravity. The results will then be compared with data provided by astronauts during previous missions. Glenn continues blood sample analysis and blood processing that are part of the Protein Turnover (PTO) experiment, which is studying the muscle loss that occurs during space flight.

CASI

*Space Transportation System Flights; Space Transportation System; Spacecrews; Microgravity; Gravitational Effects; Chemical Analysis; Bone Marrow*

**19990008755** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 02 Highlights**

Oct. 31, 1998; In English; Videotape: 27 min. 1 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998397354; BRF-1416B; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

On this second day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, are seen preparing a glovebox device in the middeck area of Discovery, an enclosed research facility that will support numerous science investigations throughout the mission. Payload Specialist John Glenn, activates the Microgravity Encapsulation Process experiment (MEPS). This experiment will study the formation of capsules containing two kinds of anti-tumor drugs that could be delivered directly to solid tumors with applications for future chemotherapy treatments and the pharmaceutical industry.

Author

*Space Transportation System Flights; Space Transportation System; Spacecrews; Gravitational Effects; Chemotherapy*

**19990008756** NASA Johnson Space Center, Houston, TX USA

**STS-95 Day 01 Highlights**

Oct. 30, 1998; In English; Videotape: 25 min. 10 sec. playing time, in color, with sound

Report No.(s): NONP-NASA-VT-1998397353; BRF-1416A; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta



On this first day of the STS-95 mission, the flight crew, Cmdr. Curtis L. Brown, Pilot Steven W. Lindsey, Mission Specialists Scott E. Parazynski, Stephen K. Robinson, and Pedro Duque, and Payload Specialists Chiaki Mukai and John H. Glenn, can be seen performing pre-launch activities such as eating the traditional breakfast, crew suit-up, and the ride out to the launch pad. Also, included are various panoramic views of the shuttle on the pad. The crew is readied in the 'white room' for their mission. After the closing of the hatch and arm retraction, launch activities are shown including countdown, engine ignition, launch, and the separation of the Solid Rocket Boosters.

CASI

*Space Transportation System Flights; Space Shuttle Boosters; Launching; Countdown; Booster Rocket Engines; Spacecrews*

## 18

### SPACECRAFT DESIGN, TESTING AND PERFORMANCE

*Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see 54 Man/System Technology and Life Support. For related information see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation.*

**19990008476** Computer Sciences Corp., Huntsville, AL USA

**A Compendium of Wind Statistics and Models for the NASA Space Shuttle and Other Aerospace Vehicle Programs *Final Report***

Smith, O. E., Computer Sciences Corp., USA; Adelfang, S. I., Computer Sciences Corp., USA; Oct. 1998; 116p; In English

Contract(s)/Grant(s): NAS8-60000

Report No.(s): NASA/CR-1998-208859; NAS 1.26:208859; M-899; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The wind profile with all of its variations with respect to altitude has been, is now, and will continue to be important for aerospace vehicle design and operations. Wind profile databases and models are used for the vehicle ascent flight design for structural wind loading, flight control systems, performance analysis, and launch operations. This report presents the evolution of wind statistics and wind models from the empirical scalar wind profile model established for the Saturn Program through the development of the vector wind profile model used for the Space Shuttle design to the variations of this wind modeling concept for the X-33 program. Because wind is a vector quantity, the vector wind models use the rigorous mathematical probability properties of the multivariate normal probability distribution. When the vehicle ascent steering commands (ascent guidance) are wind biased to the wind profile measured on the day-of-launch, ascent structural wind loads are reduced and launch probability is increased. This wind load alleviation technique is recommended in the initial phase of vehicle development. The vehicle must fly through the largest load allowable versus altitude to achieve its mission. The Gumbel extreme value probability distribution is used to obtain the probability of exceeding (or not exceeding) the load allowable. The time conditional probability function is derived from the Gumbel bivariate extreme value distribution. This time conditional function is used for calculation of wind loads persistence increments using 3.5-hour Jimsphere wind pairs. These increments are used to protect the commit-to-launch decision. Other topics presented include the Shuttle load-response to smoothed wind profiles, a new gust model, and advancements in wind profile measuring systems. From the lessons learned and knowledge gained from past vehicle programs, the development of future launch vehicles can be accelerated. However, new vehicle programs by their very nature will require specialized support for new databases and analyses for wind, atmospheric parameters (pressure, temperature, and density versus altitude), and weather. It is for this reason that project managers are encouraged to collaborate with natural environment specialists early in the conceptual design phase. Such action will give the lead time necessary to meet the natural environment design and operational requirements, and thus, reduce development costs.

Author

*Wind Profiles; Wind Effects; Mathematical Models; Wind Velocity Measurement; Gust Loads; Climbing Flight*

**19990008536** Boeing Defense and Space Group, Huntsville, AL USA

**EXPRESS Rack Technology for Space Station**

Davis, Ted B., Boeing Defense and Space Group, USA; Adams, J. Brian, Boeing Defense and Space Group, USA; Fisher, Edward M., Jr., Boeing Defense and Space Group, USA; Prickett, Guy B., Boeing Defense and Space Group, USA; Smith, Timothy G., Boeing Defense and Space Group, USA; [1998]; 20p; In English; International Space Station Utilization, 31 Jan. 1999, Albuquerque, NM, USA

Contract(s)/Grant(s): NAS8-50000; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The EXPRESS rack provides accommodations for standard Mid-deck Locker and ISIS drawer payloads on the International Space Station. A design overview of the basic EXPRESS rack and two derivatives, the Human Research Facility and the Habitat Holding Rack, is given in Part I. In Part II, the design of the Solid State Power Control Module (SSPCM) is reviewed. The SSPCM is a programmable and remotely controllable power switching and voltage conversion unit which distributes and protects up to 3kW of 120VDC and 28VDC power to payloads and rack subsystem components. Part III details the development and testing of a new data storage device, the BRP EXPRESS Memory Unit (BEMU). The BEMU is a conduction-cooled device which operates on 28VDC and is based on Boeing-modified 9GB commercial disk-drive technology. In Part IV results of a preliminary design effort for a rack Passive Damping System (PDS) are reported. The PDS is intended to isolate ISPR-based experiment racks from on-orbit vibration. System performance predictions based on component developmental testing indicate that such a system can provide effective isolation at frequencies of 1 Hz and above.

Author

*Electric Potential; Data Storage; Research Facilities; Space Stations; Performance Prediction; International Space Station*

**19990008547** NASA Ames Research Center, Moffett Field, CA USA

**Integrated Thermal Insulation System for Spacecraft**

Kolodziej, Paul, Inventor, NASA Ames Research Center, USA; Bull, Jeff, Inventor, NASA Ames Research Center, USA; Kowalski, Thomas, Inventor, NASA Ames Research Center, USA; Switzer, Matthew, Inventor, NASA Ames Research Center, USA; Sep. 08, 1998; 8p; In English

Patent Info.: Filed 22 Apr. 1996; NASA-Case-ARC-14052-1SB; US-Patent-5,803,406; US Patent-Appl-656144; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An integrated thermal protection system (TPS) for a spacecraft includes a grid that is bonded to skin of the spacecraft, e.g., to support the structural loads of the spacecraft. A plurality of thermally insulative, relatively large panels are positioned on the grid to cover the skin of the spacecraft to which the grid has been bonded. Each panel includes a rounded front edge and a front flange depending downwardly from the front edge. Also, each panel includes a rear edge formed with a rounded socket for receiving the rounded front edge of another panel therein, and a respective rear flange depends downwardly from each rear edge. Pins are formed on the front flanges, and pin receptacles are formed on the rear flanges, such that the pins of a panel mechanically interlock with the receptacles of the immediately forward panel. to reduce the transfer to the skin of heat which happens to leak through the panels to the grid, the grid includes stringers that are chair-shaped in cross-section.

Official Gazette of the U.S. Patent and Trademark Office

*Spacecraft Shielding; Curved Panels; Thermal Insulation*

**19990008595** NASA Ames Research Center, Moffett Field, CA USA

**Leading Edge Heat Shield for Wings of Spacecraft**

Stewart, David A., Inventor, NASA Ames Research Center, USA; Jun. 30, 1998; 5p; In English

Patent Info.: Filed 28 Nov. 1995; NASA-Case-ARC-14031-1GE; US-Patent-5,772,154; US-Patent-Appl-SN-563418; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A heat shield for thermally insulating the leading edge of a wing of a spacecraft during ascent and reentry includes a plurality of rigid tiles. Each tile is formed with a pie-shaped element which interlocks with the complementarily-formed element of another tile. The combination of structure afforded by the pie-shaped elements substantially impedes hypersonic flow of any gases that might enter the gaps between tiles.

Official Gazette of the U.S. Patent and Trademark Office

*Heat Shielding; Wings; Spacecraft Design; Thermal Insulation*

**19990008652** NASA Lewis Research Center, Cleveland, OH USA

**SAMS Acceleration Measurements on Mir From January to May 1997 (NASA Increment 4)**

DeLombard, Richard, NASA Lewis Research Center, USA; Oct. 1998; 265p; In English; Original contains color illustrations Contract(s)/Grant(s): RTOP 963-60-0D

Report No.(s): NASA/ TM-1998-208646; E-11363; NAS 1.15:208646; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

During NASA Increment 4 (January to May 1997), about 5 gigabytes of acceleration data were collected by the Space Acceleration Measurements System (SAMS) onboard the Russian Space Station, Mir. The data were recorded on 28 optical disks which were returned to Earth on STS-84. During this increment, SAMS data were collected in the Priroda module to support the Mir Structural Dynamics Experiment (MiSDE), the Binary Colloidal Alloy Tests (BCAT), Angular Liquid Bridge (ALB), Candle Flames in Microgravity (CFM), Diffusion Controlled Apparatus Module (DCAM), Enhanced Dynamic Load Sensors (EDLS),

Forced Flow Flame Spreading Test (FFFT), Liquid Metal Diffusion (LMD), Protein Crystal Growth in Dewar (PCG/Dewar), Queen's University Experiments in Liquid Diffusion (QUELD), and Technical Evaluation of MIM (TEM). This report points out some of the salient features of the microgravity environment to which these experiments were exposed. Also documented are mission events of interest such as the docked phase of STS-84 operations, a Progress engine burn, Soyuz vehicle docking and undocking, and Progress vehicle docking. This report presents an overview of the SAMS acceleration measurements recorded by 10 Hz and 100 Hz sensor heads. The analyses included herein complement those presented in previous summary reports prepared by the Principal Investigator Microgravity Services (PIMS) group.

Author

*Microgravity; Spaceborne Experiments; Accelerometers; Satellite Sounding; Acceleration Measurement*

**19990008769** NASA Marshall Space Flight Center, Huntsville, AL USA

**EXPRESS Service to the International Space Station: EXPRESS Pallet**

Primm, Lowell, NASA Marshall Space Flight Center, USA; Bergmann, Alan, Boeing Defense and Space Group, USA; [1998]; 6p; In English; STAIF '99 Conference on ISS Utilization, Jan. 1999, Albuquerque, NJ, USA

Contract(s)/Grant(s): NAS8-50000; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The International Space Station (ISS) will be the ultimate scientific accomplishment in the history of NASA, with its primary objective of providing unique scientific investigation opportunities. This objective is the basis for the creation of the EXPRESS Pallet System (ExPs). The EXPRESS Pallet will provide extremal/unpressurized accommodations for a wide variety of external users. The payload developers represent many science disciplines, including earth observation, communications, solar and deep space viewing, long-term exposure, and many others. The EXPRESS Pallet will provide a mechanism to maximum utilization of the limited ISS unpressurized payload volume, standard physical payload interfaces for users, a standard integration template for users and the capability to changeout payloads on-orbit. The EXPRESS Pallet provides access to Ram, Wake, Starboard, Port, Nadir, Zenith and Earth Limb for exposure and viewing. 'Me ExPs consists of the Pallet structure, payload Adapters, and a subsystem assembly which includes data controller, power distribution and conversion, and Extra Vehicular Robotics/Extra-Vehicular Activity systems.

Author

*Controllers; Control Systems Design; Accommodation; Payloads; Adapters; Services*

**19990008874** National Aerospace Lab., Tokyo, Japan

**Effect of Supersonic Retroject on Capsule Aerodynamic Characteristics in Hypersonic Flow**

Watanabe, M., National Aerospace Lab., Japan; Nomura, S., National Aerospace Lab., Japan; Yamamoto, Y., National Aerospace Lab., Japan; Yoshizawa, A., National Aerospace Lab., Japan; Hozumi, K., National Aerospace Lab., Japan; Jul. 1997; 48p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108888; NAL-TR-1329; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The effects of supersonic retrojects on the aerodynamic characteristics of a capsule type model a with a spherical nose of large bluntness were investigated experimentally in a hypersonic flow. Tests were conducted in the NAl phi = 50 cm hypersonic wind tunnel at conditions of Mach number 7.1, Reynolds number of 40,000/cm and angles of attack from 0 to 15 degrees. The capsule model has the so-called GEMINI type configuration: a spherical forebody with bluntness ratio of 4.0 (spherical nose radius/base radius) followed by a conical boattail and a cylinder. The tests were conducted by focusing on the effect of the blowing rate of a supersonic retroject of a nominal Mach number 3.05 ejected perpendicularly at the capsule nose center and on the effect of model attack angles. The retroject was found to have a large effect on drag and lift coefficients that were calculated by integrating the measured pressure distributions. The aerodynamic interaction phenomena between a main flow and a retroject were studied to understand those effects by investigating Schlieren pictures and surface pressure distribution.

NTIS

*Hypersonic Flow; Hypersonic Wind Tunnels; Space Capsules; Aerodynamic Drag*

**19990008880** Naval Postgraduate School, Monterey, CA USA

**FUTURE Satellite Technology. The Role of Nanoelectronics**

Rice, John S.; Sep. 1998; 64p; In English

Report No.(s): AD-A355660; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Tiny earth-orbiting spacecraft known as nanosatellites are now possible due to breakthroughs in microelectromechanics that permit engineers to build extremely small yet fully functional devices. With today's satellite launch costs averaging around \$20,000 per pound lifted into space, nanosatellites could revolutionize the future of space access by significantly reducing the size,

mass, power requirements, complexity and ultimately the costs of space systems. The small satellite concept fosters a faster evolution in space science and introduces and tests state-of-the-art space technology of the technologies required to design a miniaturized and yet autonomous vehicle, nanoelectronics is at the forefront. The field of nanoelectronics is primarily concerned with integrated circuit (IC) technology for scale sizes well below 100 nanometers. It is in this realm that the quantum-mechanical nature of the electron becomes of paramount importance. With the tools of quantum physics, reduction in the size of individual transistors has yielded the quantum dot; a three-dimensional structure for confinement of a single electron. The theoretical study in this thesis will show that the width in p-n junctions is generally underestimated for curved interfaces by textbook formulas. This result is significant for semi-cylindrical quantum dots which are the logical result of continued down scaling in semiconductor devices.

DTIC

*Microelectronics; Artificial Satellites; Quantum Mechanics; Aerospace Engineering*

**19990009081** NASA, Washington, DC USA

**VentureStar(trademark) Reaping the Benefits of the X-33 Program**

Sumrall, J., NASA, USA; Lane, C., Lockheed Martin Corp., USA; 1998; 15p; In English; 49th; International Astronautical Congress, 28 Sep. - 2 Oct. 1998, Melbourne, Australia

Report No.(s): IAF-98-V.3.03; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Major X-33 flight hardware has been delivered, and assembly of the vehicle is well underway in anticipation of its flight test program commencing in the summer of 1999. Attention has now turned to the operational VentureStar(trademark), the first single-stage-to-orbit (SSTO) reusable launch vehicle. Activities are grouped under two broad categories: (1) vehicle development and (2) market/business planning, each of which is discussed. The mission concept is presented for direct payload delivery to the International Space Station and to low Earth orbit, as well as payload delivery with an upper stage to Geosynchronous Transfer Orbit (GTO) and other high energy orbits. System requirements include flight segment and ground segment. Vehicle system sizing and design status is provided including the application of X-33 traceability and lessons learned. Technology applications to the VentureStar(trademark) are described including the structure, propellant tanks, thermal protection system, aerodynamics, subsystems, payload bay and propulsion. Developing a market driven low cost launch services system for the 21 st Century requires traditional and non-traditional ways of being able to forecast the evolution of the potential market. The challenge is balancing both the technical and financial assumptions of the market. This involves the need to provide a capability to meet market segments that in some cases are very speculative, while at the same time providing the financial community with a credible revenue stream.

Author

*X-33 Reusable Launch Vehicle; Single Stage to Orbit Vehicles; Mission Planning; Geosynchronous Orbits; Payloads; Flight Tests*

**19990009082** NASA Marshall Space Flight Center, Huntsville, AL USA

**Transient Analysis of X-34 Pressurization System**

Hedayat, A., Sverdrup Technology, Inc., USA; Knight, K. C., Sverdrup Technology, Inc., USA; Champion, R. H., Jr., NASA Marshall Space Flight Center, USA; 1998; 6p; In English; 10th; PERC Annual Propulsion Symposium, 26-27 Oct. 1998, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-40836; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Two transient operational modes of the X-34 pressurization system were analyzed using the ROCKET Engine Transition Simulation (ROCETS) program. The first operational mode considers the normal operation. For the engine burn period, the required helium mass and pressure of each propellant tank were calculated. In the second case, the possibility of failure of the pressurization system solenoid valves, its consequence on the over-pressurization, and simultaneous operation of pressurization and vent/relief systems were evaluated.

Author

*X-34 Reusable Launch Vehicle; Rocket Engines; Fuel Tank Pressurization; Helium; Propellant Tanks*



## SPACECRAFT PROPULSION AND POWER

*Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also 07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion, and 15 Launch Vehicles and Space Vehicles.*

**19990008485** NASA Lewis Research Center, Cleveland, OH USA

### **Electric Propulsion for Low Earth Orbit Constellations**

Oleson, Steven R., DYNACS Engineering Co., Inc., USA; Sankovic, John M., NASA Lewis Research Center, USA; Nov. 1998; 12p; In English; 1998 JANNAF Propulsion, 15-17 Jul. 1998, Cleveland, OH, USA; Sponsored by Johns Hopkins Univ., USA Contract(s)/Grant(s): RTOP 022-00-00

Report No.(s): NASA/TM-1998-208821; E-11427; NAS 1.15:208821; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Hall Effect electric propulsion was evaluated for orbit insertion, satellite repositioning, orbit maintenance and de-orbit applications for a sample low earth orbit satellite constellation. Since the low masses of these satellites enable multiple spacecraft per launch, the ability to add spacecraft to a given launch was used as a figure of merit. When compared to chemical propulsion, the Hall thruster system can add additional spacecraft per launch using planned payload power levels. One satellite can be added to the assumed four satellite baseline chemical launch without additional mission times. Two or three satellites may be added by providing part of the orbit insertion with the Hall system. In these cases orbit insertion times were found to be 35 and 62 days. Depending on the electric propulsion scenario, the resulting launch vehicle savings is nearly two, three or four Delta 7920 launch vehicles out of the chemical baseline scenarios eight Delta 7920 launch vehicles.

Author

*Electric Propulsion; Constellations; Low Earth Orbits; Satellite Constellations*

**19990008510** NASA Marshall Space Flight Center, Huntsville, AL USA

### **Summary of Rocketdyne Engine A5 Rocket Based Combined Cycle Testing**

Ketchum, A., Boeing Co., USA; Emanuel, Mark, Boeing Co., USA; Cramer, John, NASA Marshall Space Flight Center, USA; 1998; 17p; In English; 10th, 26-27 Oct. 1998, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-40894; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Rocketdyne Propulsion and Power (RPP) has completed a highly successful experimental test program of an advanced rocket based combined cycle (RBCC) propulsion system. The test program was conducted as part of the Advanced Reusable Technology program directed by NASA-MSFC to demonstrate technologies for low-cost access to space. Testing was conducted in the new GASL Flight Acceleration Simulation Test (FAST) facility at sea level (Mach 0), Mach 3.0 - 4.0, and vacuum flight conditions. Significant achievements obtained during the test program include 1) demonstration of engine operation in air-augmented rocket mode (AAR), ramjet mode and rocket mode and 2) smooth transition from AAR to ramjet mode operation. Testing in the fourth mode (scramjet) is scheduled for November 1998.

Author

*Performance Tests; Experimentation; Propulsion; Supersonic Combustion Ramjet Engines; Cycles*

**19990008537** NASA Marshall Space Flight Center, Huntsville, AL USA

### **Status of Liquid Oxygen/Liquid Methane Injector Study for a Mars Ascent Engine**

Trinh, Huu Ogyic, NASA Marshall Space Flight Center, USA; Cramer, John M., NASA Marshall Space Flight Center, USA; 1998; 8p; In English; 10th; PERC Symposium, 26-27 Oct. 1998, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Preliminary mission studies for human exploration of Mars have been performed at Marshall Space Flight Center (MSFC). These studies indicate that for non-toxic chemical rockets only a cryogenic propulsion system would provide high enough performance to be considered for a Mars ascent vehicle. Although the mission is possible with Earth-supplied propellants for this vehicle, utilization of in-situ propellants is highly attractive. This option would significantly reduce the overall mass of the return vehicle. Consequently, the cost of the mission would be greatly reduced because the number and size of the Earth launch vehicle(s) needed for the mission decrease. NASA/Johnson Space Center has initiated several concept studies (2) of in-situ propellant production plants. Liquid oxygen (LOX) is the primary candidate for an in-situ oxidizer. In-situ fuel candidates include methane (CH<sub>4</sub>), ethylene (C<sub>2</sub>H<sub>4</sub>), and methanol (CH<sub>3</sub>OH). MSFC initiated a technology development program for a cryogenic propulsion system for the Mars human exploration mission in 1998. One part of this technology program is the effort described here: an evaluation of propellant injection concepts for a LOX/liquid methane Mars Ascent Engine (MAE) with an emphasis on light-weight, high

efficiency, reliability, and thermal compatibility. In addition to the main objective, hot-fire tests of the subject injectors will be used to test other key technologies including light-weight combustion chamber materials and advanced ignition concepts. This state-of-the-art technology will then be applied to the development of a cryogenic propulsion system that will meet the requirements of the planned Mars sample return (MSR) mission. The current baseline propulsion system for the MSR mission uses a storable propellant combination [monomethyl hydrazine/mixed oxides of nitrogen-25(MMH/MON-25)]. However, a mission option that incorporates in-situ propellant production and utilization for the ascent stage is being carefully considered as a subscale precursor to a future human mission to Mars.

Derived from text

*Liquid Oxygen; Mars Exploration; Cryogenic Rocket Propellants; Launch Vehicles; Ethylene; Methyl Alcohol; Liquefied Gases*

**19990008651** NASA Lewis Research Center, Cleveland, OH USA

**Emittance Theory for Cylindrical Fiber Selective Emitter**

Chubb, Donald L., NASA Lewis Research Center, USA; Nov. 1998; 14p; In English; 4th; Thermophotovoltaic Generation of Electricity (TPV4), 11-14 Oct. 1998, Denver, CO, USA; Sponsored by National Renewable Energy Lab., USA

Contract(s)/Grant(s): RTOP 632-1A-1A

Report No.(s): NASA /TM-1998-208656; E-11378; NAS 1.15:208656; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A fibrous rare earth selective emitter is approximated as an infinitely long cylinder. The spectral emittance,  $\epsilon(\lambda)$ , is obtained by solving the radiative transfer equations with appropriate boundary conditions and uniform temperature. For optical depths,  $K(\lambda) = \alpha(\lambda)R$ , where  $\alpha(\lambda)$  is the extinction coefficient and  $R$  is the cylinder radius, greater than 1 the spectral emittance is nearly at its maximum value. There is an optimum cylinder radius,  $R(\text{opt})$ , for maximum emitter efficiency,  $\eta(E)$ . Values for  $R(\text{opt})$  are strongly dependent on the number of emission bands of the material. The optimum radius decreases slowly with increasing emitter temperature, while the maximum efficiency and useful radiated power increase rapidly with increasing temperature.

Author

*Emitters; Radiative Transfer; Spectral Emission; Emittance; Thermal Emission; Metal Surfaces*

**19990008765** NASA Marshall Space Flight Center, Huntsville, AL USA

**Detection, Location, and Classification of Space Shuttle Main Engine Nozzle Leaks by Transient Thermographic Inspection**

Russell, Samuel S., NASA Marshall Space Flight Center, USA; Walker, James L., Alabama Univ., USA; 1998; 9p; In English; National Space and Missile Materials Symposium, 19-22 Oct. 1998, Colorado Springs, CO, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Leak checking and evaluation of pressure vessels by observing the slight temperature changes resulting from structural anomalies has been made possible through developments in high resolution infrared cameras and advanced image processing. These developments have made thermal nondestructive analysis a very practical and efficient method to determine material consistency and structural quality as well as monitor processes. The Space Shuttle Main Engine Nozzle has regions which can not be inspected with standard leak check methods. The Thermographic methods being developed to nondestructively test the Nozzle for leaks in inaccessible regions are reported. Also, a flash heating Thermographic investigation of the braze line bonding the cooling tubes to the outer structural jacket of the nozzle is reported.

Author

*Detection; Position (Location); Classifications; Space Shuttle Main Engine; Nozzle Design; Leakage; Thermography; Inspection*

**19990008767** NASA Lewis Research Center, Cleveland, OH USA

**Launch Vehicle Performance with Solid Particle Feed Systems for Atomic Propellants**

Palaszewski, Bryan, NASA Lewis Research Center, USA; Nov. 1998; 26p; In English; 34th; Propulsion, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 260-98-09

Report No.(s): NASA/TM-1998-208498; E-11294; NAS 1.15:208498; AIAA Paper 98-3736; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis of launch vehicle Gross Liftoff Weight (GLOW) using high energy density atomic propellants with solid particle feed systems was conducted. The analyses covered several propellant combinations, including atoms of aluminum (Al), boron (B), carbon (C), and hydrogen (H) stored in a solid cryogenic particle, with a cryogenic liquid as the carrier fluid. Several different weight percents (wt%) for the liquid carrier were investigated and the gross lift off weight (GLOW) of the vehicles using the solid

particle feed systems were compared with a conventional O<sub>2</sub>/H<sub>2</sub> propellant vehicle. The potential benefits and effects of feed systems using solid particles in a liquid cryogenic fluid are discussed.

Author

*Experimentation; Launch Vehicles; Liftoff (Launching); Feed Systems; Carbon; Boron; Weight (Mass)*

**19990008838** National Aerospace Lab., Tokyo, Japan

**Effect of Laser-Cracking Method of ZrO<sub>2</sub>/Ni Thermal Barrier Coating for Regeneratively Cooled Thrust Chamber Evaluated by Combustion Gas of NTO/MMH Propellant**

Kuroda, Y., National Aerospace Lab., Japan; Moriya, S., National Aerospace Lab., Japan; Tadano, M., National Aerospace Lab., Japan; Sato, M., National Aerospace Lab., Japan; Moro, A., National Aerospace Lab., Japan; Dec. 1997; 34p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108920; NAL-TR-1339; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

An evaluation test of laser cracking specimens applied to ZrO<sub>2</sub>/Ni functionally graded materials (FGM) and non-FGM is described. In this test, 30 mm disk specimens of these materials were exposed to the combustion gas of nitrogen tetroxide (NTO) and monomethyl hydrazine (MMH) propellant. Delamination and vertical crack formation of the ZrO<sub>2</sub> thermal barrier coating were observed during the heating test. It was found that the laser cracking method seemed to be effective at preventing delamination in the coating layer of the test specimens. The crack and the delamination formation mechanisms for ZrO<sub>2</sub>/Ni FGM test specimens are also discussed with a thermal stress analysis by using a finite element method.

NTIS

*Thrust Chambers; Combustion; Gases; Nitrogen Tetroxide; Thermal Control Coatings; Regenerative Cooling; Rocket Propellants*

**19990008876** Aerospace Corp., Technology Operations, El Segundo, CA USA

**Ground Cloud Dispersion Measurements During The Titan IV Mission #B33 (15 October 1997) at Cape Canaveral Air Station**

Jun. 30, 1998; 89p; In English

Contract(s)/Grant(s): F04701-93-C-0094

Report No.(s): AD-A354948; TR-98(1410)-3; SMC-TR-98-31; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report presents plume imagery documenting the development and dispersion of the Titan IV #B33 launch ground cloud at Cape Canaveral Air Station on 15 October 1997 at 0443 EDT. Also presented are pertinent meteorological data taken from towers, Doppler radars, and rawinsonde balloons. IR cameras were used at four locations around the launch site to track the trajectory and time evolution of the exhaust ground cloud for 1.5-2.5 min following launch. Meteorological data were collected to improve understanding of cloud dispersion and to use as input during model simulations and evaluations. Rawinsonde balloon data, 915 MHz Doppler radar data, and meteorological tower data were collected and archived. These data and similar data from other launches will be used to determine the accuracy of atmospheric dispersion models such as the Rocket Exhaust Effluent Diffusion Model (REEDM) in predicting toxic hazard corridors (THCs) at the USAF Eastern and Western Ranges. Reduction of available imagery data yielded limited information on cloud rise and dispersion. The imagery showed that the bottom edge of the launch cloud rose above the altitude of the bottom of the atmospheric clouds (514 m AGL) within 2.3 min after launch. REEDM 7.08 predicted that the bottom edge of the launch cloud would stabilize at 480 m AGL. The bottom of the actual launch cloud therefore rose at least 7% higher than predicted by REEDM 7.08. Analysis of the imagery also showed that the rising cloud had an air entrainment coefficient (ratio of increase in diameter to increase in altitude) of 0.39. This is significantly smaller than the default air entrainment coefficient of 0.64 that is used in REEDM 7.08.

DTIC

*Rocket Exhaust; Effluents; Data Acquisition; Exhaust Clouds*

**19990008885** NASA Marshall Space Flight Center, Huntsville, AL USA

**Fastrac Rocket Engine Combustion Chamber Acoustic Cavities**

Christensen, Eric, Sverdrup Technology, Inc., USA; Nesman, Tom, NASA Marshall Space Flight Center, USA; 1998; 6p; In English; 10th; Propulsion, 26-27 Oct. 1998, Huntsville, AL, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS8-40836; NASA Project 242-34-ZT; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A three dimensional modal analysis was performed using finite fluid elements. The analysis shows four distinct modes of the Fastrac chamber plus cavities near the frequency of the chamber first tangential mode. The mode shapes illustrate the complexity of fluid oscillations in a three dimensional chamber and acoustic cavity. In addition, a first tangential forcing function was

applied to the chamber with three different acoustic cavity fluid temperatures. It was observed that the acoustic cavity fluid temperature has a significant effect on the response of the chamber to first tangential mode oscillations.

Author

*Three Dimensional Models; Combustion Chambers; Rocket Engines; Cavities*

**19990008956** United Space Boosters, Inc., Cocoa Beach, FL USA

**Cathodic Protection Deployment on Space Shuttle Solid Rocket Boosters**

Zook, Lee M., United Space Boosters, Inc., USA; 1998; 11p; In English; Cathodic Protection, 3 Nov. 1998, Norfolk, VA, USA; Sponsored by American Society for Testing and Materials, USA

Contract(s)/Grant(s): NAS8-36300; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Corrosion protection of the space shuttle solid rocket boosters incorporates the use of cathodic protection(anodes) in concert with several coatings systems. The SRB design has large carbon/carbon composites(motor nozzle) electrically connected to an aluminum alloy structure. Early in the STS program, the aluminum structures incurred tremendous corrosive attack due primarily to the galvanic couple to the carbon/carbon nozzle at coating damage locations. Also contributing to the galvanic corrosion problem were stainless steel and titanium alloy components housed within the aluminum structures and electrically connected to the aluminum structures. This paper will highlight the evolution in the protection of the aluminum structures, providing historical information and summary data from the operation of the corrosion protection systems. Also, data and information will be included regarding the evaluation and deployment of inorganic zinc rich primers as anode area on the aluminum structures.

Author

*Cathodic Coatings; Space Shuttle Boosters; Corrosion Prevention; Protection; Rocket Nozzles*

**19990009043** National Aerospace Lab., Tokyo, Japan

**Observation of the Cavitation in Rocket Turbopump Inducer, 1st Report, Effect of Casing Geometry**

Watanabe, M., National Aerospace Lab., Japan; Hashimoto, T., National Aerospace Lab., Japan; Watanabe, Y., National Aerospace Lab., Japan; Hasegawa, S., National Aerospace Lab., Japan; Yamada, H., National Aerospace Lab., Japan; Nov. 1997; 20p; In Japanese

Report No.(s): PB99-108839; NAL-TR-1325; Copyright Waived; Avail: Issuing Activity (Nat'l Technical Information Service (NTIS)), Microfiche

Some observations of rotating cavitation in a rocket turbopump inducer were made with three types of casing: a modified, an original and a straight casing. Rotating cavitation was observed with the original casing at the design flow rate, but was not observed with the modified or the straight one. The region of occurrence of rotating cavitation with the modified or the straight casing seemed to be shifted to a higher flow rate range, which might be caused by the backflow at the inducer inlet. It is also reported that the low cycle oscillation that occurred after attached cavitation is related to rotating cavitation and attached cavitation.

NTIS

*Cavitation Flow; Turbine Pumps; Rocket Engines; Linings*

**19990009075** GenCorp Aerojet, Sacramento, CA USA

**Strutjet Matures to Support Propulsion Needs in the 2000+ World**

Siebenhaar, A., GenCorp Aerojet, USA; Bulman, M. J., GenCorp Aerojet, USA; 1998; 4p; In English; 14th, 5-10 Sep. 1999, Turin, Italy

Contract(s)/Grant(s): NAS8-40891; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Abstract Only; Abstract Only

The Strutjet, Aerojet's Rocket Based Combined Cycle (RBCC) concept, was discussed in a previous ISABE paper as an enabling propulsion concept for single stage to orbit applications. This paper describes the technical progress of the Strutjet since 1996 together with a rationale why RBCC engines in general and the Strutjet in particular, lend themselves uniquely to systems having the ability to expand current space and also open new global "rapid delivery" markets. In particular, the paper substantiates the claims why for certain missions RBCC powered vehicles can be operated at higher margins than all rocket systems, and why within the family of conceivable RBCC systems the Strutjet excels due to its unique architecture and design features. A special emphasis is given to the selection of the engine's ram/scram mode design point because only that mode can add significantly to the mission effective Isp. The thrust produced by an airbreathing engine is directly related to the mass of air processed. This air is captured by the inlet and compressed to raise the pressure for combustion and subsequent expansion. The net accelerating force is the difference between the gross thrust and total vehicle drag (including the spill drag). This total drag is highest at low speeds when the gross thrust is lowest. When the net accelerating force is low, most of the fuel burned is wasted overcoming the vehicle drag. Higher



thrust is necessary to perform the mission. One method is to leave the rockets on longer but this results in much higher propellant consumption.

Author

*Propulsion; Thrust; Propellant Consumption; Air Breathing Engines; Combustion; Drag*

**19990009078** Pennsylvania State Univ., Propulsion Engineering Research Center, State College, PA USA

**Rocket Ignition Demonstrations Using Silane**

Pal, Sibtosch, Pennsylvania State Univ., USA; Santoro, Robert, Pennsylvania State Univ., USA; Watkins, William B., Pratt and Whitney Aircraft, USA; Kincaid, Kevin, Pratt and Whitney Aircraft, USA; Oct. 14, 1998; 5p; In English; 10th; Propulsion Symposium, 26-27 Oct. 1998, Huntsville, AL, USA

Contract(s)/Grant(s): RTOP 242-72-01; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Rocket ignition demonstration tests using silane were performed at the Penn State Combustion Research Laboratory. A heat sink combustor with one injection element was used with gaseous propellants. Mixtures of silane and hydrogen were used as fuel, and oxygen was used as oxidizer. Reliable ignition was demonstrated using fuel lead and a swirl injection element.

Author

*Ignition; Rockets; Hydrogen; Silanes; Gas Mixtures; Combustion*

**23**

**CHEMISTRY AND MATERIALS (GENERAL)**

**19990008477** United Space Boosters, Inc., Materials and Processes Dept., Huntsville, AL USA

**Evaluation of Convergent Spray Technology(TM) Spray Process for Roof Coating Application**

Scarpa, J., United Space Boosters, Inc., USA; Creighton, B., United Space Boosters, Inc., USA; Hall, T., United Space Boosters, Inc., USA; Hamlin, K., United Space Boosters, Inc., USA; Howard, T., United Space Boosters, Inc., USA; Sep. 1998; 50p; In English

Report No.(s): PB99-104697; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The overall goal of this project was to demonstrate the feasibility of(CST) Convergent Spray Technology (Trademark) for the roofing industry. This was accomplished by producing an environmentally compliant coating utilizing recycled materials, a CST(Trademark) spray process portable application cart, and hand-held applicator with a CST(Trademark) spray process nozzle. The project culminated with application of this coating to a nine hundred sixty square foot metal for NASA Marshall Space Flight Center (MSFC) in Huntsville, Alabama.

NTIS

*Pollution Control; Sprayed Coatings; Roofs; Spray Nozzles*

**19990008586** NASA Johnson Space Center, Houston, TX USA

**Distributed Pore Chemistry in Porous Organic Polymers**

Koontz, Steven L., Inventor, NASA Johnson Space Center, USA; Aug. 25, 1998; 16p; In English; Continuation-in-part of abandoned US-Patent-Appl-SN-857901, filed 26 Mar. 1992, US-Patent-5,369,012, and a continuation-in-part of abandoned US-Patent-Appl-SN-997265, filed 23 Feb. 1993, US-Patent-5,332,551

Patent Info.: Filed 3 Jun. 1994; NASA-Case-MS-C-22419-1; US-Patent-5,798,261; US-Patent-Appl-SN-254361; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A method for making a biocompatible polymer article using a uniform atomic oxygen treatment is disclosed. The sub-strate may be subsequently optionally grated with a compatibilizing compound. Compatibilizing compounds may include proteins, phosphorylcholine groups, platelet adhesion preventing polymers, albumin adhesion promoters, and the like. The compatibilized substrate may also have a living cell layer adhered thereto. The atomic oxygen is preferably produced by a flowing afterglow microwave discharge, wherein the substrate resides in a sidearm out of the plasma. Also, methods for culturing cells for various purposes using the various membranes are disclosed as well. Also disclosed are porous organic polymers having a distributed pore chemistry (DPC) comprising hydrophilic and hydrophobic region, and a method for making the DPC by exposing the polymer to atomic oxygen wherein the rate of hydrophilization is greater than the rate of mass loss.

Official Gazette of the U.S. Patent and Trademark Office

*Porosity; Procedures; Proteins; Adhesion; Afterglows*

**19990008715** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA  
**Hydrogen Plasma Removal of Military Paints: Chemical Characterization of Samples** *Final Report, Mar. 1997 - May 1998*  
Kaste, P. J.; Daniel, R. G.; Pesce-Rodriguez, R. A.; Schroeder, M. A.; Escarsega, J. A.; Oct. 1998; 79p; In English  
Contract(s)/Grant(s): Proj-1L161102AH43

Report No.(s): AD-A354821; ARL-TR-1825; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A moderate temperature hydrogen plasma has been developed for removal of chemical-agent-resistant coating (CARC) propellant coatings, and the chemistry and morphology of the CARC removal process has been investigated. A microwave-based plasma generator, producing a low-temperature atomic beam was used to treat the samples. The plasma heats the sample only 10-20 deg C. Additional heat was supplied to maintain temperatures of 200-300 deg C. Helium and hydrogen plasmas were studied in this effort. However, helium was not at all effective, showing that atomic bombardment alone is not sufficient to remove the paint, and that chemical reactivity is needed. One of the CARC paints studied, a conventional formulation, is on the qualified products list, while the other two formulations are experimental. Paint variables that were studied include: one- and two-pack formulations; moisture-cured and water-reducible chemistries; aluminum with chromate, and steel with zinc phosphate conversion coatings; and presence or absence of an adhesive epoxy sublayer. The samples were characterized by microreflectance and photoacoustic Fourier-transform infrared spectroscopies. Heat treatment to 300 deg C resulted in some degradation of the conventional CARC, but the experimental CARC was mostly unaffected. The hydrogen plasma removed up to 50 weight-percent of the CARC layers, but was much more effective in degrading the conventional formulation. Virtually all of the urea, amine, and polyurethane (present in the resin as a prepolymer) functional groups were removed by the H-plasma in the case of the conventional propellant, whereas in the experimental paints, these groups were only slightly reduced.

DTIC

*Adhesives; Aluminum; Amines; Atomic Beams; Atoms; Chemical Attack*

**19990008819** Cornell Univ., School of Civil and Environmental Engineering, Ithaca, NY USA  
**Compendium of Technical Papers on the Reductive Dechlorination of Chlorinated Solvents** *Final Report, Aug. 1993 - Oct. 1996*

Gossett, J. M., Cornell Univ., USA; Zinder, S. H., Cornell Univ., USA; Aug. 1997; 50p; In English

Report No.(s): AD-A354532; AFRL-ML-TR-1998-4536; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This compendium of technical papers represents three years of work in the investigation of the anaerobic biodegradation of tetrachloroethylene (PCE). Cornell researchers had previously developed a methanol (MeOH)/PCE enrichment culture which dechlorinates high concentrations of PCE and other chlorinated ethenes to ethene (ETH), representing complete detoxification. This culture dechlorinates PCE at unprecedented, high rates with efficient use of MeOH as the electron donor for reductive dechlorination. However, research at Cornell showed that MeOH was not the direct donor for PCE dechlorination, but rather H<sub>2</sub>. MeOH and other reductants found to support dechlorination merely serve as H<sub>2</sub> precursors. Three alternative electron donors (ethanol, butyrate, and lactate) were evaluated to circumvent the problem of methanogenic competition for the supplied donor. The final selected substrate was used in a continuous-flow reactor study with the H<sub>2</sub>/PCE enrichment culture. Engineering studies examined the kinetics of, chlorinated ETH utilization, with emphasis on vinyl chloride (VC) dechlorination to ETH. Acclimation and induction issues were explored. Microbiological studies towards a better understanding of the nature and the requirements of the dechlorinating organisms were explored. The nutrition of the dechlorinating organisms was examined with the goal of finding and identifying reliable high-potency sources if the nutrients.

DTIC

*Chlorination; Solvents; Biodegradation; Microbiology; Chlorine Compounds*

**19990008907** Research and Technology Organization, RTO Applied Vehicle Technology Panel, Neuilly-sur-Seine, France  
**Intelligent Processing of High Performance Materials** *Le Traitement Sophistique de Matériaux Très Performants*  
Nov. 1998; 164p; In English, 13-14 May 1998, Brussels, Belgium; Also announced as 19990008908 through 19990008923  
Report No.(s): RTO-MP-9; AC/323(AVT)TP/5; ISBN 92-837-1004-5; Copyright Waived; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report contains the papers presented at a Workshop on Intelligent Processing of High Performance Materials organised by the Applied Vehicle Technology Panel (AVT) of RTO, in Brussels, Belgium, 13-14 May 1998. The papers describe various aspects of intelligent processing, a methodology for simulating and controlling the processing and manufacturing of materials, which is finding widespread application during the manufacture of functional electronic, photonic, and composite materials as

well as primary metals such as steel and aluminium. The papers are presented under the following headings: Overview and analytical techniques, Metallic materials applications, and Non-metallic materials applications.

Author

*Process Control (Industry); Artificial Intelligence; Materials Science; Manufacturing; Composite Materials; Computerized Simulation; Metals*

**19990008970** Brigham Young Univ., Dept. of Chemistry and Biochemistry, Provo, UT USA

**Assessment of Exposure to Sensitizing Rosin-Derived Compounds from Electronics Soldering Final Report, 1 Jun - 30 Apr. 1998**

Bowerbank, Christopher R.; Lee, Milton L.; Nov. 06, 1998; 77p; In English

Contract(s)/Grant(s): N00014-97-1-08666

Report No.(s): AD-A355713; R0200793; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Exposure potential for rosin-derived compounds, including volatile and semivolatile organic compounds produced during electronics soldering operations using rosin-based fluxes and rosin core solders, was investigated. A reaction system was constructed for trapping emission products. Particulate matter was collected on filters, and volatile organic compounds were collected on sorbent tube media for analysis by gas chromatography/mass spectrometry (GC/MS). Comparisons were made between reaction system samples and actual breathing zone samples collected during soldering operations. Other work included: (1) A protein conjugation/haptenation mechanism for 7-oxodehydroabiatic acid, an oxidized resin acid compound present in aerosol produced by heating rosin flux, (2) Identification of low molecular weight aldehydes in soldering emissions using gas chromatography/mass spectrometry (GC/MS), (3) In vitro studies of resin acid metabolism to identify mammalian metabolites produced from dehydroabiatic acid, and (4) A rapid method for analyzing headspace sampling of aldehydes using solvating gas chromatography (SGC). This project provided information regarding the specific compounds generated during rosin heating in electronic soldering applications. A possible biological mechanism was shown for sensitization to a resin acid present in aerosol produced during heating rosin flux. The work described may prove useful in producing an exposure standard for contaminant sampling during electronics soldering operations.

DTIC

*Low Molecular Weights; Mass Spectroscopy; Gas Chromatography; Organic Compounds*

**19990008998** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Asymmetric Synthesis of 3-(1-Phenylethylamino)-1-propanol from 3-[(1-Phenylethylidene)amino]propene by a Sequence of Hydroboration/Imine Reduction**

Tanaka, Junji, Kyushu Univ., Japan; Mimaki, Hiroaki, Kyushu Univ., Japan; Kanemasa, Shuji, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 71-78; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A new synthetic method consisting of a hydroboration/imine reduction sequence is described. Hydroboration of 3-[(1-phenylethylidene)amino]-propene with optically pure isopinocampheylborane is followed by the reaction with diethylzinc and then the oxidation with hydrogen peroxide to produce 3-(1 phenylethylamino)-1-propanol with a moderate enantioselectivity. The alkylborane produced in the hydroboration step forms a chiral five membered complex structure which induces the new chirality in the imine reduction step.

Author

*Asymmetry; Synthesis (Chemistry); Hydroboration; Imines; Amines*

**19990009005** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Synthetic Photochemistry, Report 66, The Photoaddition of 2-Oxo-gamma-valerolactone to Cyclohexene**

Hatsui, Toshihide, Kyushu Univ., Japan; Kitashima, Toshio, Kyushu Univ., Japan; Takeshita, Hitoshi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 17-21; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Photocycloaddition of 4-methyl-2-oxo-gamma-valerolactone to cyclohexene gave three [2+2] cycloadducts. The stereoisomers of photoproducts were identified by detailed NMR spectral analyses including NOE experiments. The photocycloadducts were convertible to [2-(1 propenyl)cyclo-hexyl]glyoxylic acids.

Author

*Photochemical Reactions; Synthesis (Chemistry); Methyl Compounds*

**19990009035** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Synthesis and Mercurophilic Properties of Bis(2-troponyl) Thioethers of Di-, Tri-, and Tetraethylene Glycols**

Mori, Akira, Kyushu Univ., Japan; Kubo, Kanji, Kyushu Univ., Japan; Hirayama, Shun-ichi, Kyushu Univ., Japan; Takeshita, Hitoshi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 185-188; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Condensation reaction of 2-(p-toluenesulfonyloxy)troponone with bis(2-mercaptoethyl) ethers of ethylene glycol homologues afforded bis(2-troponyl) thioethers of oligoethylene glycol derivatives. Due to an acyclic nature of polyethylene glycol moiety, they formed complexes with various metal ions. Reversible complexes with mercury salts were recognized.

Author

*Synthesis (Chemistry); Glycols; Mercury (Metal); Ethers; Ethylene Compounds*

## 24

### COMPOSITE MATERIALS

*Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see 27 Nonmetallic Materials.*

**19990008596** NASA Ames Research Center, Moffett Field, CA USA

**Flexible Ceramic-Metal Insulation Composite and Method of Making**

Rasky, Daniel J., Inventor, NASA Ames Research Center, USA; Sawko, Paul M., Inventor, NASA Ames Research Center, USA; Kilodziej, Paul, Inventor, NASA Ames Research Center, USA; Kourtides, Demetrius A., Inventor, NASA Ames Research Center, USA; Apr. 28, 1998; 7p; In English; Continuation-in-part of abandoned US-Patent-Appl-SN-700368, filed 6 May 1991

Patent Info.: Filed 11 Jan. 1993; NASA-Case-ARC-11989-1GE; US-Patent-5,744,252; US-Patent-Appl-SN-075367; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A method for joining a woven flexible ceramic fabric and a thin metal sheet creating an integral metal surfaced flexible thermal protection article, which methods compress: placing multiple dots of high temperature metallic or fabric and the thin metal sheet in a random or organized pattern, with the proviso that the brazing material covers about 10% or less of the surface of one flat side of the metal sheet; heating the flexible ceramic fabric, brazing material and thin metal sheet for a predetermined period of time to integrally connect the same; and cooling the formed flexible article to ambient temperature. Preferably the flexible ceramic is selected from fibers comprising atoms of silicon, carbon, nitrogen, boron, oxygen or combinations thereof. The flexible thermal protection article produced is also part of the present invention. The thin metal sheet is comprised of titanium, aluminum, chromium, niobium or alloys or combinations thereof. The brazing material is selected from copper/silver or copper/gold or is a ceramic brazing or adhesive material.

Author

*Ceramics; Thermal Protection; Ambient Temperature; Chromium Alloys; Aluminum Alloys; Fabrics; Metal Sheets; Niobium Alloys; Materials Science*

**19990008598** Cleveland State Univ., Dept. of Materials Science, Cleveland, OH USA

**Wear and Friction Behavior of Metal Impregnated Microporous Carbon Composites**

Goller, Gultekin, Cleveland State Univ., USA; Koty, D. P., Cleveland State Univ., USA; Tewari, S. N., Cleveland State Univ., USA; Singh, S. N., NYMA, Inc., USA; Tekin, A., Technical Univ. of Istanbul, Turkey; Metallurgical and Materials Transactions A; Nov. 1996; Volume 27A, pp. 3727-3738; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Metal-matrix composites have been prepared by pressure-infiltration casting of copper-base alloy melts into microporous carbon preforms. The carbon preforms contained varying proportions of amorphous carbon and graphite. Load dependence of the wear and friction behavior of the composite pins has been examined under ambient conditions against cast-iron plates, using a pin-on-plate reciprocating wear tester. The wear resistance of the composite is significantly improved, as compared with the base alloy. Contrary to the normally expected behavior, the addition of graphite to the amorphous carbon does not reduce the friction coefficient, especially at high loads. The wear and friction behavior of the composites is very sensitive to the size and distribution of the microstructural constituents.

Author

*Wear Resistance; Friction Reduction; Carbon; Amorphous Materials; Coefficient of Friction; Iron Alloys; Metal Matrix Composites*



**19990008648** NASA Lewis Research Center, Cleveland, OH USA

**Flow/Damage Surfaces for Fiber-Reinforced Metals Having Different Periodic Microstructures**

Lissenden, Cliff J., Pennsylvania State Univ., USA; Arnold, Steven M., NASA Lewis Research Center, USA; Iyer, Saiganesh K., Pennsylvania State Univ., USA; Nov. 1998; 33p; In English

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA/TM-1998-208805; E-11389; NAS 1.15:208805; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flow/damage surfaces can be defined in terms of stress, inelastic strain rate, and internal variables using a thermodynamics framework. A macroscale definition relevant to thermodynamics and usable in an experimental program is employed to map out surfaces of constant inelastic power in various stress planes. The inelastic flow of a model silicon carbide/ titanium composite system having rectangular, hexagonal, and square diagonal fiber packing arrays subjected to biaxial stresses is quantified by flow/damage surfaces that are determined numerically from micromechanics, using both finite element analysis and the generalized method of cells. Residual stresses from processing are explicitly included and damage in the form of fiber-matrix debonding under transverse tensile and/or shear loading is represented by a simple interface model. The influence of microstructural architecture is largest whenever fiber-matrix debonding is not an issue; for example in the presence of transverse compressive stresses. Additionally, as the fiber volume fraction increases, so does the effect of microstructural architecture. With regard to the micromechanics analysis, the overall inelastic flow predicted by the generalized method of cells is in excellent agreement with that predicted using a large number of displacement-based finite elements.

Author

*Fiber Composites; Metal Matrix Composites; Micromechanics; Finite Element Method; Microstructure; Damage; Shear Stress; Strain Rate; Transverse Loads*

**19990008653** NASA Lewis Research Center, Cleveland, OH USA

**Fabrication and Resistivity of IBr Intercalated Vapor-Grown Carbon Fiber Composites**

Gaier, James R., NASA Lewis Research Center, USA; Smith, Jaclyn M., Manchester Coll., USA; Gahl, Gregory K., Manchester Coll., USA; Stevens, Eric C., Manchester Coll., USA; Gaier, Elizabeth M., Manchester Coll., USA; Nov. 1998; 15p; In English; 5th; Composites Engineering, 5-11 Jul. 1998, Las Vegas, NV, USA; Sponsored by International Community for Composites Engineering, Unknown

Contract(s)/Grant(s): RTOP 632-1E-1E

Report No.(s): NASA /TM-1998-208493; E-11282; NAS 1.15:208493; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Composites using vapor-grown carbon fibers (VGCF), the most conductive of the carbon fiber types, are attractive for applications where low density, high strength, and at least moderate conductivity are required, such as electromagnetic interference shielding covers for spacecraft. The conductivity can be enhanced another order of magnitude by intercalation of the VGCF. If a high Z intercalate is used, the protection of components from ionizing radiation can be enhanced also. Thus, the intercalation of VGCF with IBr is reported. Since composite testing is required to verify properties, the intercalation reaction optimization, stability of the intercalation compound, scale-up of the intercalation reaction, composite fabrication, and resistivity of the resulting composites is also reported. The optimum conditions for low resistivity and uniformity for the scaled up reaction (20-30 g of product) were 114 C for at least 72 hr, yielding a fiber with a resistivity of  $8.7 \pm 2$  mW-cm. The thermal stability of these fibers was poor, with degradation occurring at temperatures as low as 40 C in air, though they were insensitive to water vapor. Composite resistivity was  $200 \pm 30$  mW-cm, as measured by contactless conductivity measurements, about a factor of five higher than would be expected from a simple rule of mixtures. The addition of 1.0 percent Br 2 intercalated microfibers increased the resistivity of the composites by more than 20 percent.

Author

*Carbon Fibers; Intercalation; Electrical Resistivity; Fiber Composites; Spacecraft Shielding; Fabrication*

**19990008719** Army Construction Engineering Research Lab., Champaign, IL USA

**Development and Demonstration of Advanced Design Composite Structural Components Final Report**

Howdyshell, Paul A.; Trovillion, Jonathan C.; GangaRao, Hota V.; Lopez-Anido, Roberto; Jul. 1998; 78p; In English

Report No.(s): AD-A354825; CERL-TR-98/99; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Composite materials have been demonstrated to be effective in high-performance applications where traditional materials fail, especially in aggressively corrosive environments. Many corrosion-resistant applications are industrial load-bearing elements, but the construction industry has mainly used composites in nonstructural applications. Most fiber-reinforced polymer (FRP) composites have not been optimized for civil engineering applications, and conventional civil engineering design proce-

dures may not effectively exploit the unique mechanical properties of FRP composites or adequately define potential failure mechanisms. The objective of this work was to develop, test, and demonstrate optimized, advanced-design composite structural components for civil engineering applications. First, new glass FRP fiber architectures were developed, tested, and optimized. Next, using the optimized fiber architecture, a pultruded interlocking hexagonal structural system called the H-Deck was designed, tested, and compared with performance standards published by the American Association of State Highway and Transportation Officials (AASHTO). Finally, two short-span FRP composite H-deck demonstration bridges were successfully constructed. Detailed results from the testing and optimization phases of the study are documented, and economic analysis suggests that life-cycle costs for properly selected FRP composite H-Deck applications will be lower than for comparable reinforced concrete applications. Information on the commercial availability of the composite H-Deck system is also provided.

DTIC

*Composite Materials; Composite Structures; Concretes; Construction Industry; Corrosion; Corrosion Resistance*

**19990008831** NASA Lewis Research Center, Cleveland, OH USA

**Flow/Damage Surfaces for Fiber-Reinforced Metals having Different Periodic Microstructures**

Lissenden, Cliff J., Pennsylvania State Univ., USA; Arnold, Steven M., NASA Lewis Research Center, USA; Iyer, Saiganesh K., Pennsylvania State Univ., USA; Nov. 1998; 32p; In English

Contract(s)/Grant(s): NCC3-481; RTOP 523-21-13

Report No.(s): NASA/TM-1998-208805; NAS 1.15:208805; E-11389; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Flow/damage surfaces can be defined in terms of stress, inelastic strain rate, and internal variables using a thermodynamics framework. A macroscale definition relevant to thermodynamics and usable in an experimental program is employed to map out surfaces of constant inelastic power in various stress planes. The inelastic flow of a model silicon carbide/ titanium composite system having rectangular, hexagonal, and square diagonal fiber packing, arrays subjected to biaxial stresses is quantified by flow/damage surfaces that are determined numerically from micromechanics. using both finite element analysis and the generalized method of cells. Residual stresses from processing are explicitly included and damage in the form of fiber-matrix debonding under transverse tensile and/or shear loading is represented by a simple interface model. The influence of microstructural architecture is largest whenever fiber-matrix debonding is not an issue, for example in the presence of transverse compressive stresses. Additionally, as the fiber volume fraction increases, so does the effect of microstructural architecture. With regard to the micromechanics analysis, the overall inelastic flow predicted by the generalized method of cells is in excellent agreement with that predicted using a large number of displacement-based finite elements.

Author

*Metals; Microstructure; Micromechanics; Stress-Strain Relationships; Transverse Loads; Finite Element Method; Fiber Composites; Debonding (Materials); Axial Stress*

**19990008915** Naval Air Systems Command, Aerospace Materials Div., Patuxent , MD USA

**Intelligent Processing of P/M Materials**

Frazier, William E., Naval Air Systems Command, USA; Waldman, Jeffrey, Drexel Univ., USA; Parrish, Phillip A., MATSYS, Inc., USA; Nov. 1998; 8p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Emphasis is being placed on the acquisition of affordable, reliable, and sustainable advanced airframes and propulsion systems. Net-shape processing of high performance structural materials is of significant technological interest because of its potential for decreasing the cost and enhancing the performance of these aircraft components. Component cost is reduced because of the intrinsic high material utilization and a reduction in machining and finishing operations. The net-shape, hot isostatic press (HIP) consolidation of particulate materials (P/M) is considered one of the enabling technologies for the consolidation of costly and difficult to melt-process materials. This paper explores the benefits of P/M processing and focuses on the development of an intelligent hot isostatic press (IHIP).

Author

*Process Control (Industry); Computer Aided Manufacturing; Hot Isostatic Pressing; Smart Materials; Aircraft Structures; Costs*

**19990008923** Aerospatiale, CCR Louis Bleriot, Suresnes, France

**Smart Curing of Composite Materials in Autoclave**

Dublineau, P., Aerospatiale, France; Cinquin, J., Aerospatiale, France; Nov. 1998; 3p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A01, Hardcopy; A02, Microfiche

When fabricating structures made of fibre reinforced organic matrix composites careful attention must be paid to the manufacturing procedures. The quality of the part may suffer and the cost may become excessive if improper manufacturing processes are used. Therefore, the manufacturing process must be selected carefully to ensure that both the quality and the cost are acceptable. The major process variables which must be selected and controlled are the heat and pressure applied during autoclave curing of thermosetting matrix composites. Although the aforementioned process variables can be chosen empirically, the empirical approach is undesirable and often impractical. Empirical, trial, and error methods are expensive and time consuming, and do not ensure that the resulting processing conditions are optimum. It is far more advantageous and convenient to establish the required process conditions and process variables either by the use of analytical models, or by expert systems. AEROSPATIALE as developed software SCOOP-POLYM(R) for modelling and simulation of cure processes of structures made of fibre reinforced organic matrix composites. This presentation describes a computerised definition of optimise cure cycle to the simultaneous control of materials reaction behaviour and consolidation dynamics in autoclave. General output of cure simulation is the optimum cure cycle used by the autoclave temperature controller. This cycle takes in account: Part definition (material, fibre, geometry), Polymerisation tools and environment, Autoclave characteristic, and Autoclave loading (position of parts inside the autoclave). In addition a dynamic control of the polymerisation could be made using dielectric sensors inside the composite part. The real time control can be use as a feedback closed-loop control modification of autoclave power based on actual reaction behaviour of material. Cure simulation and dynamic control of the autoclave process improve cured product quality and reduce fabrication cost by providing: Process optimisation, Reduced process inconsistencies and product rejections, Verification of process reaction behaviour kinetics, Non destructive verification of cured properties, Accurate, permanent process documentation, and Flexibility in adapting to new of modified process (material, tool...).

Author

*Process Control (Industry); Expert Systems; Computer Aided Manufacturing; Dynamic Control; Feedback Control; Fiber Composites; Real Time Operation; Smart Materials; Curing; Autoclaves*

**19990008952** Tel-Aviv Univ., Ramat-Aviv, Dept. of Solid Mechanics, Materials and Structures, Tel-Aviv, Israel

**Micromechanical Prediction of the Effective Coefficients of Thermo-Piezoelectric Multiphase Composites Final Report**

Aboudi, Jacob, Tel-Aviv Univ., Ramat-Aviv, Israel; Nov. 1998; 26p; In English

Contract(s)/Grant(s): NAS3-97190; RTOP 523-21-13

Report No.(s): NASA/CR-1998-208521; E-11376; NAS 1.26:208521; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The micromechanical generalized method of cells model is employed for the prediction of the effective elastic, piezoelectric, dielectric, pyroelectric and thermal-expansion constants of multiphase composites with embedded piezoelectric materials. The predicted effective constants are compared with other micromechanical methods available in the literature and good agreements are obtained.

Author

*Micromechanics; Piezoelectricity; Thermal Expansion; Dielectrics*

**19990008957** NASA Lewis Research Center, Cleveland, OH USA

**Fabrication and Resistivity of IBr Intercalated Vapor-Grown Carbon Fiber Composites**

Gaier, James R., NASA Lewis Research Center, USA; Smith, Jaclyn M., Manchester Coll., USA; Gahl, Gregory K., Manchester Coll., USA; Stevens, Eric C., Manchester Coll., USA; Gaier, Elizabeth M., Manchester Coll., USA; Nov. 1998; 16p; In English; 5th; Composites Engineering, 5-11 Jul. 1998, Las Vegas, NV, USA; Sponsored by International Community for Composites Engineering, Unknown

Contract(s)/Grant(s): RTOP 632-1E-1E

Report No.(s): NASA/TM-1998-208493; NAS 1.15:208493; E-11282; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Composites using vapor-grown carbon fibers (VGCF), the most conductive of the carbon fiber types, are attractive for applications where low density, high strength, and at least moderate conductivity are required, such as electromagnetic interference shielding covers for spacecraft. The conductivity can be enhanced another order of magnitude by intercalation of the VGCF. If a high Z intercalate is used, the protection of components from ionizing radiation can be enhanced also. Thus, the intercalation of VGCF with IBr is reported. Since composite testing is required to verify properties, the intercalation reaction optimization, stability of the intercalation compound, scale-up of the intercalation reaction, composite fabrication, and resistivity of the resulting composites is also reported. The optimum conditions for low resistivity and uniformity for the scaled up reaction (20-30 g of product) were 114 C for at least 72 hr, yielding a fiber with a resistivity of 8.7+-2 micro-Ohm-cm. The thermal stability of these fibers was poor, with degradation occurring at temperatures as low as 40 C in air, though they were insensitive to water vapor.

Composite resistivity was 20-30 micro-Ohm-cm, as measured by contactless conductivity measurements, about a factor of five higher than would be expected from a simple rule of mixtures. The addition of 1.0 percent Br<sub>2</sub>, intercalated microfibers increased the resistivity of the composites by more than 20 percent.

Author

*Electromagnetic Interference; Electrical Resistivity; Carbon Fibers; Fiber Composites; High Strength; Microfibers; Intercalation*

**19990008963** Amoco Polymer, Inc., Alpharetta, GA USA

**Avionics Composite Evaluation**

Sullivan, B. J.; Houston, J. C.; Jan. 1998; 5p; In English

Report No.(s): AD-A355840; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Designers of electronic systems for current and next generation missiles systems are placing more emphasis on reduced weight, increased functionality and improved reliability. With the advent of large scale integration and multi-chip modules, packaging engineers are rapidly reaching a point where more electronic components can be integrated into electronic systems than what can be effectively cooled by traditional metal materials. This has resulted in the development of an increasing number of new composite materials that can provide improvements over conventional packaging materials. These improvements include better thermal management, higher strength and stiffness, and significant weight savings. One composite material constituent being investigated to address these future requirements is high modulus pitch-based graphite fibers. These fibers exhibit thermal conductivity of up to three times that of copper in the fiber direction, are light weight and have a very low coefficient of thermal expansion (CTE). These fibers can be combined with a number of different matrix materials such as polymers and metals, depending on the specific application. This paper focuses on the implementation of high modulus pitch-based graphite composites into two areas of missile avionics, chassis covers and printed wiring board (PWB) thermal plane/constraining cores. For these two applications, a significant weight savings was realized, thermal performance improved and mechanical integrity maintained by replacing aluminum with pitch-based graphite fiber reinforced organic matrix composites.

DTIC

*Composite Materials; Thermal Conductivity; Printed Circuits; Matrix Materials; Large Scale Integration*

**19990008972** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

**A Comparison of Normal and Accelerated Ageing of GRP Laminates Immersed in Seawater**

Gellert, E. P.; Turley, D. M.; Apr. 1998; 39p; In English

Report No.(s): AD-A355721; DSTO-TR-0668; DODA-AR-010-537; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Glass fibre reinforced plastic (GRP) materials for marine applications undergo losses to mechanical properties during ageing. This study examined a polyester, a phenolic and two vinylester GRP materials. Specimens were immersed in seawater, unloaded or loaded at a high service temperature of 30 deg C, or at 50 deg C as an accelerated ageing condition. Water uptake was monitored. After ageing to near saturation the losses in flexural strength ranged from 15 to 25% for the unloaded specimens. Loading in flexure at 20% of the strain to fail while ageing did not significantly affect the water uptake or losses to mechanical properties. Greater losses in mechanical properties from the 50 deg C immersion were accompanied by indications of abnormal degradation. The accelerated ageing condition therefore appears unsuitable for the assessment of these materials.

DTIC

*Glass Fiber Reinforced Plastics; Flexural Strength; Mechanical Properties*

**19990009073** NASA Lewis Research Center, Cleveland, OH USA

**Fabrication Routes for Continuous Fiber-Reinforced Ceramic Composites (CFCC)**

DiCarlo, James A., NASA Lewis Research Center, USA; Bansal, Narottam P., NASA Lewis Research Center, USA; Nov. 1998; 20p; In English

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA/TM-1998-208819; NAS 1.15:208819; E-11424; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche



The primary approaches used for fabrication of continuous fiber-reinforced ceramic composite (CFCC) components have been reviewed. The CFCC fabrication issues related to fiber, interface, and matrix have been analyzed. The capabilities, advantages and limitations of the five matrix-infiltration routes have been compared and discussed. Today, the best fabrication route for the CFCC end-user is not clear and compromises need to be made depending on the details of the CFCC application. However, with time, this problem should be reduced as research continues to develop advanced CFCC constituents and fabrication routes.

Author

*Ceramic Matrix Composites; Composite Materials; Fiber Composites; Ceramic Fibers; Carbon-Carbon Composites*

**19990009083** National Defence Research Establishment, Div. of Guidance and Control, Materials and Underwater Sensors, Stockholm, Sweden

**Sandwich Element with Thermoplastic Matrix for Load Carrying Microwave Windows: Mechanical Properties** *Sandwich-element med Termoplastmatris foer Lastbaerande Mikrovagsfoenster: Hallfasthetsegenskaper*

Larsson, F., National Defence Research Establishment, Sweden; Apr. 1998; 24p; In Swedish

Report No.(s): PB99-103426; FOA-R-98-00756-615-SE; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

The aim of the reported work is to manufacture a sandwich element with honey comb core and facings of fiber reinforced thermoplastics. The problem has been solved by bonding purchased components with an adhesive thermoplastic film. The bonding was performed in a press under vacuum, pressure and heat. The process window is very narrow due to the risk of degradation and buckling of the core. Tensile strength of the bond is low compared to what can be obtained with a corresponding thermosetting combination and an epoxy adhesive film, due to the low capacity of the thermoplastic film for forming fillets at the openings of the core cells. The relatively low tensile strength gives cause for studying alternative bonding methods. Such methods are proposed.

NTIS

*Sandwich Structures; Thermoplasticity; Thermoplastic Films; Loads (Forces); Microwaves; Reinforcing Fibers; Matrix Materials*

## 25

### INORGANIC AND PHYSICAL CHEMISTRY

*Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also 77 Thermodynamics and Statistical Physics.*

**19990008470** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Reaction of Carbon Disulfide and O-Phenylene Diamine by Tertiary Amine in the Presence of Potassium Hydroxide**

Liu, Biing-Lang, National Tsing Hua Univ., Taiwan, Province of China; Wang, Maw-Ling, National Tsing Hua Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 317-325; In English

Contract(s)/Grant(s): NSC85-0402-E-007-004; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The reaction of carbon disulfide and o-phenylene diamine catalyzed by tertiary amine in the presence of KOH in an aqueous solution/organic solvent two-phase medium was carried out. The reaction was greatly enhanced by adding a small amount of tertiary amine in the presence of KOH. The reaction of synthesizing 2-mercaptobenzimidazole (MBI) first took place in the organic phase. However, the potassium salt of MBI, which was produced from the reaction of MBI and KOH at the interface between  $\text{CH}_2\text{Cl}_2$  and  $\text{H}_2\text{O}$ , dissolved in the aqueous phase. The greatest advantage of using this process is that MBI in crystal form can then be precipitated from the aqueous solution by adding an acidic compound. Based on the experimental data, a reaction mechanism was proposed. The reaction of synthesizing MBI was first initiated by reacting  $\text{CS}_2$  and  $\text{R}_3\text{N}$  to produce an active intermediate ( $\text{R}_3\text{N-CS}_2$ ). This active intermediate further reacted with o-phenylene diamine to produce the desired MBI product. In addition, potassium hydroxide also reacted with  $\text{H}_2\text{S}$ , which is a byproduct from the synthesis of MBI, to enhance the reaction. The reaction of  $\text{CS}_2$  and  $\text{C}_6\text{H}_4(\text{NH}_2)_2$  in a two-phase medium is described by a pseudo-first-order rate law.

Author

*Amines; Potassium Hydroxides; Carbon Disulfide; Hydrogen Sulfide; Diamines; Chemical Reactions; Phenyls*

**19990008664** Duke Univ., Dept. of Chemistry, Durham, NC USA

**Preparation of Nanocrystalline Indium Antimonide Through Beta-Hydride Elimination from New Indium-Antimony Single-Source Precursors**

Foos, Edward E., Duke Univ., USA; Welis, Richard L., Duke Univ., USA; Rheingold, Arnold L., Delaware Univ., USA; Oct. 22, 1998; 23p; In English N00015-95-1-0194

Report No.(s): AD-A355240; DU/DC/TR-79; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The 1:1 mole ratio reaction of t-Bu<sub>3</sub>In with Sb(SiMe<sub>3</sub>)<sub>3</sub> results in the formation of the Lewis acid-base adduct t-Bu<sub>3</sub>In.Sb(SiMe<sub>3</sub>)<sub>3</sub> (I), while the dimeric compound T-Bu<sub>2</sub>InSb(SiMe<sub>3</sub>)<sub>2</sub> (II) is isolated from the 1:1 reaction of t-Bu<sub>2</sub>InCl with Sb(SiMe<sub>3</sub>)<sub>3</sub>. Both the 2:1 reactions of t-Bu<sub>2</sub>InCl with Sb(SiMe<sub>3</sub>)<sub>3</sub> and t-Bu<sub>2</sub>InCl with (II) result in the formation of the mixed-bridge compound t-Bu<sub>2</sub>InSb(SiMe<sub>3</sub>)<sub>2</sub>In(t-Bu)<sub>2</sub>Cl (III), however 1H NMR studies suggest that this compound is unstable in solution. Thermolysis of I, II, and t-Bu<sub>3</sub>Ga.Sb(SiMe<sub>3</sub>)<sub>3</sub> (IV) results in the formation of nanocrystalline InSb or GaSb through a beta-hydride elimination pathway.

DTIC

*Indium Antimonides; Antimony; Acid Base Equilibrium*

**19990008666** NASA Marshall Space Flight Center, Huntsville, AL USA

**Heat Treatments of ZnSe Starting Materials for Physical Vapor Transport**

Su, Ching-Hua, NASA Marshall Space Flight Center, USA; Palosz, W., Universities Space Research Association, USA; Feth, S., Hughes STX, Inc., USA; Lehoczy, S. L., NASA Marshall Space Flight Center, USA; Journal of Crystal Growth; 1997; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

The effect of different heat treatments on stoichiometry and residual gas pressure in ZnSe physical vapor transport system was investigated. The dependence of the amount and composition of the residual gas on various heat treatment procedures is reported. Heat treatment of ZnSe starting materials by baking under the condition of dynamic vacuum to adjust its stoichiometry was performed and the effectiveness of the treatment was confirmed by the measurements of the partial pressure of Se<sub>2</sub>, P(sub Se<sub>2</sub>), in equilibrium with the heat treated samples. Optimum heat treatment procedures on the ZnSe starting material for the physical vapor transport process are discussed and verified experimentally.

Author

*Heat Treatment; Selenium; Partial Pressure; Gas Pressure; Vacuum; Vapors*

**19990008717** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

**Variation in Strength of an Unconventional CH...O Hydrogen Bond in an Engineered Protein Cavity *Final Report, Jan. 1996 - Jan 1997***

Musah, Rabi A.; Jensen, Gerard M.; Rosenfeld, Robin J.; McRee, Duncan E.; Goodin, David B.; Oct. 1998; 23p; In English Contract(s)/Grant(s): Proj-1L161102AH43

Report No.(s): AD-A354823; ARL-TR-1826; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We have utilized the ligand binding properties of a buried cavity created in the interior of a protein to obtain direct information about the variation in the strength of CH...O interactions between the ligand and protein. Our study shows that the strength of CH...O interactions can be modulated by over 1 kcal/mol by changes in the C-H bond polarity. Consequently, several such interactions may play a significant role in the stability of macromolecular structures.

DTIC

*C Band; Cavities; Hydrogen Bonds; Ligands*

**19990008739** Kagoshima Univ., Faculty of Engineering, Japan

**Cyclic Operation of Catalytic Cyclohexane Dehydrogenation/Carbon Dioxide Hydrogenation Using LaNi<sub>5</sub> As a Catalyst and as a Hydrogen Reservoir: A Fundamental Study for Membrane Separation Reactor**

Uemura, Yoshimitsu, Kagoshima Univ., Japan; Wakamatsu, Shigeki, Kagoshima Univ., Japan; Osumi, Yasuaki, Kagoshima Univ., Japan; Hatate, Yasuo, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 58, pp. 53-59; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Cyclic operation experiments of catalytic cyclohexane dehydrogenation/carbon dioxide hydrogenation were carried out using LaNi<sub>5</sub> Particles as a catalyst and as a hydrogen reservoir. The final purpose of this study is to develop a membrane separation-type catalytic reactor. Five kinds of LaNi<sub>5</sub> particles ranging from 10 to 725 micrometers in mean diameter were used. After a 30 minute activation of LaNi<sub>5</sub> using hydrogen at 673 K, carbon dioxide and cyclohexane were allowed to flow through the LaNi<sub>5</sub> particle bed for each 30 minutes at 673 K, alternatively. The cycle recurred it times. The total time of the whole operation, therefore, was 4 hours. In the case of cyclohexane feed, cyclohexene, benzene and hydrogen were detected as products. Cyclohexane

conversion increased with decreasing the mean diameter of LaNi<sub>5</sub>, i.e., with increasing external surface area per unit mass of alloy. In the case of carbon dioxide feed, carbon monoxide was formed. Hydrogen also was detected in the outlet gas. Carbon monoxide yield also increased with decreasing the mean diameter of LaNi<sub>5</sub>. to determine the amount of hydrogen in LaNi<sub>5</sub> available for carbon dioxide reduction, carbon dioxide was allowed to flow through the alloy bed until the carbon monoxide yield reached zero at 643, 653, 663 and 673 K, respectively.

Author

*Cyclohexane; Dehydrogenation; Membranes; Catalysts; Chemical Reactors*

**19990008742** Kagoshima Univ., Faculty of Engineering, Japan

**An Experimental Study on Flame Characteristics of Hydrogen Diffusion Flames**

Torii, Shuichi, Kagoshima Univ., Japan; Yano, Toshiaki, Kagoshima Univ., Japan; Iwashita, Masatatsu, Kagoshima Univ., Japan; Nishinohara, Hideki, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 35, pp. 7-12; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental study has been performed on hydrogen jet diffusion flames from vertical circular nozzles burning in free air. The direct photographic method was employed to investigate the influence of fuel flow rate and nozzle diameter,  $d$ , on the flame morphology. Emphasis was placed on the determination of the flame length,  $L(\text{sub } f)$ , over a wide range of the fuel flow rate. It became clear that (i) as the nozzle velocity is increased from zero, the flame burning under conditions of mixing with air is induced and its length is monotonically increased until a laminar-to-turbulent transition occurs, and (ii) after the transition takes place, the turbulent flame length is substantially independent of further increase in fuel jet velocity. A few relationships pertinent to the flame length, i.e.  $L(\text{sub } f)$  versus  $u(\text{sub } j)$ ,  $L(\text{sub } f)/d$  versus  $Re$ , and  $L(\text{sub } f)/d$  versus  $d$ , were proposed and examined. In the laminar diffusion flame case, effects of nozzle diameter and Reynolds number on the flame length appear if the experimental data are summarized using the dimensionless flame length,  $L(\text{sub } f)/d$ . In contrast, a slight effect of the turbulent diffusion flame is observed. The hydrogen diffusion flames, for the burner tube of 1.24 mm i. d., are found to be perfectly stable at a nozzle velocity of 300 m/s.

Author

*Hydrogen; Diffusion Flames; Jet Flow; Turbulent Diffusion; Gas Jets; Morphology; Combustion*

**19990008903** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**The Construction of an Automatic Chemical Analysis System**

Fujino, Yoshikazu, Kyushu Sangyo Univ., Japan; Kurono, Shigeru, Kyushu Sangyo Univ., Japan; Urashima, Yasuhiro, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 57-62; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Today, as pollution of the environment on the earth is a serious problem for the human in the world, researches for it must be strongly promoted. But, to study the problem, chemical researchers have to do so much chemical analysis works which are commonly monotonous and boring that their researches have not been performed efficiently. to improve the performance of chemical analysis work, we developed "an automatic chemical analysis system" which is composed with 3 robots, a belt-conveyer, turn-table and many kinds of instruments such as a hearth, a heater, an electro-magnetic feeder, an electronic balance and so on. In this paper, we introduce hardware and software configuration of the system and illustrate one of example works which were carried out by use of our system.

Author

*Chemical Analysis; Construction*

**19990008940** Illinois Univ., Dept. of Mechanical Engineering, Chicago, IL USA

**NATO Advanced Study Institute; Materials Science of Carbides, Nitrides and Borides**

Gogotsi, Yury, Illinois Univ., USA; Aug. 1998; 61p; In English; Materials Science of Carbides, Nitrides and Borides, 12-22 Aug. 1998, Saint Petersburg, Russia; Sponsored by North Atlantic Treaty Organization, Netherlands  
Contract(s)/Grant(s): N00014-98-1-1064

Report No.(s): AD-A354696; No Copyright; Avail: Abstracts Only, Microfiche

Program and compilation of abstracts from the conference entitled "NATO Advanced Study Institute: Materials Science of Carbides, Nitrides and Borides" held 12-22 August 1998 in Saint Petersburg, Russia.

DTIC

*Conferences; Borides; Nitrides*

**19990008982** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Additional Effect of Sodium Chloride in Synthesis Process of Barium Titanate**

Koga, Michio, Kyushu Sangyo Univ., Japan; Tsuru, Toshiaki, Kyushu Sangyo Univ., Japan; Matsumoto, Masaru, Kyushu Sangyo Univ., Japan; Yoshinaga, Syunichi, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 163-168; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Barium titanate is synthesized from barium carbonate and titanium in a mole ratio of 1 to 1 using the solid phase method at 1200 C. With the goal of doing synthesis at low barium titanate temperatures, NaCl was added in a weight ratio of 1-3%. The results are summarized as follows: 1) by addition of NaCl, barium titanate was able to synthesize at 200 C lower temperature than the current method; and 2) When NaCl 3% was added, the particle size of barium titanate heated to 1200 C was too large to mold.

CASI

*Barium Titanates; Synthesis (Chemistry); Sodium Chlorides; Temperature Dependence*

**19990008995** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Simultaneous Measurements of Thermal Conductivity and Diffusivity of Liquids with a Transient Short-Hot-Wire Method**

Fujii, Motoo, Kyushu Univ., Japan; Zhang, Xing, Kyushu Univ., Japan; Fujiwara, Seiji, Kyushu Univ., Japan; Tomimura, Toshio, Kyushu Univ., Japan; Imaishi, Nobuyuki, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 99-105; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A transient short-hot-wire technique has been proposed to measure the thermal conductivity and diffusivity of liquids simultaneously. To confirm its applicability and accuracy, the sample liquids with well known thermophysical properties are used. In the present method, through comparing with the numerical results obtained under the same aspect ratios and boundary conditions of the experiment, the thermal conductivity can be determined from the gradient of the temperature rise against time, and the thermal diffusivity can be obtained from the gradient and the absolute temperature rise. In the present paper, three kinds of liquids are measured, and it is found that the thermal conductivity and diffusivity can be obtained within errors of 2% and 5%, respectively. Because of the simplicity and small size of the probe, it is easy to coat an electrically insulating layer and only small amount of sample liquid is required. Therefore, this method is particularly suitable for electrically conducting liquids and valuable or expensive liquids.

Author

*Thermal Conductivity; Liquids; Thermal Diffusivity*

**19990008996** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**A Non-Contact Measurement of Thermal Conductivity and Diffusivity of Anisotropic Materials**

Fujii, Motoo, Kyushu Univ., Japan; Park, Soochun, Kyushu Univ., Japan; Tomimura, Toshio, Kyushu Univ., Japan; Zhang, Xing, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 87-98; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The purpose of this paper is to develop a non-contact method for simultaneous measurement of thermal conductivity and diffusivity of anisotropic materials. This method could be applied to biological materials. Three-dimensional transient heat conduction equation in an anisotropic solid is solved numerically when the solid surface is heated locally. Then, the time variations of non dimensional average surface temperature are obtained as a master plot, which depend on the ratio of thermal conductivities in x-, y- direction  $E(\text{sub } xy) = (\lambda(\text{sub } y) / \lambda(\text{sub } x))$ . In experiment, the surface of an anisotropic sample is heated locally, by the laser beam and the surface temperature profiles are measured by an infrared thermometer. The measured temperature variations are compared with the numerical ones to yield the thermal conductivity and diffusivity in x-direction  $\lambda(\text{sub } x)$ ,  $\alpha(\text{sub } x)$  and the ratio  $E(\text{sub } xy)$  simultaneously. To confirm the applicability and the accuracy of the present measuring method, are used the multi layered paper and vinyl chloride resin film as the samples with known thermophysical properties. It is found that the method could obtain the thermal conductivity, diffusivity and anisotropic ratio ( $E(\text{sub } xy)$ ) within errors of 6%, 25% and 4%, respectively, when the errors of measured laser output, heating radius and temperature are assumed to be within 2%, 3% and 0.2K, respectively.

Author

*Temperature Profiles; Thermal Conductivity; Anisotropy; Diffusivity; Atmospheric Temperature*



19990009010 Nagoya Inst. of Tech., Japan

**Effects of Non-Symmetrical Wake Structure on Turbulent Diffusion Flames Behind a Semi-Circular Cylinder**

Oiwa, Norio, Nagoya Inst. of Tech., Japan; Ishino, Yojiro, Nagoya Inst. of Tech., Japan; Mizutani, Tatsuhiko, Nagoya Inst. of Tech., Japan; Yamaguchi, Shigeki, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 141-149; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper, effects of non-symmetrical wake structure on turbulent diffusion flames formed behind a semi-circular cylinder are investigated, along with interactions between two vortex sheets in the cold flows, by varying the velocity ratio of the lower airstream velocity  $U_{(sub\ 2)}$  to the higher  $U_{(sub\ 1)}$  from  $U_{(sub\ 2)}/U_{(sub\ 1)} = 1.0$  to  $0.083$ . Detailed optical observations of the flames, as well as those of the cold flows, are made. The cold flows behind the semicircular cylinder are classified into three patterns, depending on the velocity ratio; the wake type flow ( $U_{(sub\ 2)}/U_{(sub\ 1)} \geq 0.5$ ), the transition flow with strong interaction between two vortex sheets ( $0.5 \geq U_{(sub\ 2)}/U_{(sub\ 1)} \geq 0.15$ ), and the free shear flow type ( $U_{(sub\ 2)}/U_{(sub\ 1)}$  body-stabilized wake flame to the plane diffusion flame, indicating a good agreement with that in the cold flow. By comparing the vortex characteristics in the cold flow with those in the reacting flow, it is found that the flame-flow interaction originates mainly from an entangled effect of the suppression of the K-H instability due to the positive temperature dependence of the kinematic viscosity, the expansion and acceleration due to the exothermic reaction, and the strong pressure fluctuations associated with the turbulent reaction.

Author

*Symmetry; Wakes; Turbulent Diffusion; Flame Propagation; Circular Cylinders; Bluff Bodies*

19990009011 Nagoya Inst. of Tech., Japan

**Acoustic Excitation of Organized Eddy Flames in a Plane Shear Layer, Report 2, Phase Locked Averaging Measurements of Fluctuations of Heat Release Rate and Light Emission**

Yamaguchi, Shigeki, Nagoya Inst. of Tech., Japan; Ishino, Yojiro, Nagoya Inst. of Tech., Japan; Kojima, Toshiaki, Nagoya Inst. of Tech., Japan; Oiwa, Norio, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 133-139; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In a previous paper, it has been reported that acoustic excitation enhances the periodicity of the organized eddy motion and the combustion process. In this study, therefore, in order to elucidate the behavior of hot gases and flames in organized eddy diffusion combustion, a computer aided phase-locked-averaging method is employed to obtain the graphical 2D contour maps of instantaneous temperature and CH light emission distributions in each phase, from the original data measured at a number of positions. Furthermore, provided that the enthalpy, and density of the gases are similar to those of air, the variation of the heat release rate is calculated directly from temperature maps, and is compared with the phase averaged sound pressure variation near the flame region and over-all CH light emission. Finally Rayleigh's integration is calculated, and found to be positive in this experiment.

Author

*Acoustic Excitation; Eddy Currents; Combustion; Periodic Variations; Flames*

19990009012 Nagoya Inst. of Tech., Japan

**Acoustic Excitation of Organized Eddy Flames in a Plane Shear Layer, Report 1, Effects of Acoustic Excitation on Combustion Properties**

Ishino, Yojiro, Nagoya Inst. of Tech., Japan; Kojima, Toshiaki, Nagoya Inst. of Tech., Japan; Oiwa, Norio, Nagoya Inst. of Tech., Japan; Yamaguchi, Shigeki, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 125-132; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The acoustic excited diffusion flames which are established in a plane mixing layer with a coherent structure are investigated experimentally to obtain the knowledge required for active control of the combustion process, in particular, the response of combustion properties to the behavior of an actuator. A planar loudspeaker flush-mounted on a duct wall at the test section, is used to introduce acoustic excitation in a flame region. First, flow visualizations are made to examine the effects of the excitation on over-all combustion properties. Thereby, the acoustic excitation was found to increase the combustion intensity, to make a close relationship between the organized eddies and flame shape, and also to enhance the periodicity of the organized eddy motion which plays an important role in the transport process. Furthermore, spectral analysis of temperature fluctuations measured in the coherent eddy region showed encouragement of the periodicity caused by acoustic excitation. On the other hand, the spectral shape of sound pressure in the duct indicated that the low-frequency-component (0-400 Hz), which is difficult to eliminate with any anti-noise device, is suppressed by the acoustic excitation, and has the great advantage of being sound-proof.

Author

*Acoustic Excitation; Shear Layers; Diffusion Flames; Mixing Layers (Fluids); Turbulent Diffusion*

**19990009019** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Synthesis of Fibric Potassium Titanate**

Nagaishi, Toshiyuki, Kyushu Sangyo Univ., Japan; Kono, Yoshihiro, Kyushu Sangyo Univ., Japan; Fujioka, Sueharu, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 129-132; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Fibric potassium titanate was synthesized from potassium carbonate and titanium oxide by the flux method. As a flux, potassium molybdate, potassium chloride, sodium chloride or their mixture was used. Fibric potassium titanate with the radius of 0.5 to 1 micron and length of 20 microns was observed by the scanning electron microscope. The dimension of the fiber is independent of the flux used. The initiation and growth processes of the fiber were discussed on the basis of the hot thermofilament method.

Author

*Synthesis (Chemistry); Potassium; Titanates; Synthetic Fibers*

**19990009058** Navy Experimental Diving Unit, Panama City, FL USA

**Lot Variability of Sofnolime 408 Carbon Dioxide Absorbent When Tested in the Cold, Jun - Aug. 1998**

Clarke, J. R., Navy Experimental Diving Unit, USA; Thompson, L. D., Navy Experimental Diving Unit, USA; Godgrey, R. J., Jr., Navy Experimental Diving Unit, USA; Aug. 1998; 33p; In English

Report No.(s): AD-A355578; NEDU-TR-O1-98; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

NEDU performed quality assurance tests on 18 lots of Sofnolime 408, a large grain sodalime made by Molecular Products. CO<sub>2</sub> absorption activity using the standard NATO tubs test was performed at initial absorbent bed temperatures of approximately 32 deg F. Moisture analyses and sieve tests were also performed on each sample. Absorption test breakthrough in the chilled bed occurred at an average of 7 min, compared to the usual 40 min duration under ambient conditions. Absorption activity was negatively correlated with increasing moisture content, and positively correlated with an increasing percentage of absorbent retained on the #8 sieve.

DTIC

*Moisture Content; Moisture; Carbon Dioxide; Ambience; Absorbers (Materials); Absorbents*

**19990009067** Naval Postgraduate School, Monterey, CA USA

**A Feasibility Study of Liquid Phase Sinter Forming of a Model Ceramic System**

Lloyd, Jason M.; Sep. 1998; 72p; In English

Report No.(s): AD-A355805; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The feasibility of a new manufacturing process of ceramic materials in which net shaped products are produced via sintering and simultaneously deforming is studied. A suitable model system of SiO<sub>2</sub>-B<sub>2</sub>O<sub>3</sub> is chosen due to its desirable properties for liquid phase sintering and its ability to be tested under atmospheric conditions. Samples of compacted powder are prepared and characterized via x-ray diffraction and scanning electron microscopy. Tests to determine the ability of the system to undergo Liquid Phase Sintering are studied. Deformation of samples in compression with concomitant Liquid Phase Sintering at nominally constant true strain rates is performed, and the effects of the amount of liquid phase present are investigated. Problems associated with the Liquid Phase Sinter Forming process are identified, and recommendations are suggested for future studies.

DTIC

*Liquid Phase Sintering; Ceramics; Manufacturing; Deformation; Microstructure; Powder Metallurgy*

**19990009072** Florida State Univ., Dept. of Chemistry, Tallahassee, FL USA

**Production of Nanosize Particles by Gas Phase Synthesis Using MOCVD Final Report, 1 Aug. 1996 - 31 Jul. 1998**

Guidry, James L.; Li, Ming; Dahmen, Klaus H.; Oct. 29, 1998; 8p; In English

Contract(s)/Grant(s): F49620-96-1-0418

Report No.(s): AD-A355866; AFRL-SR-BL-TR-98-0695; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A system for the production of nanoparticles incorporating MOCVD has been assembled at the National High Magnetic Fields Laboratory. The system comprises: 1. a microwave plasma deposition system utilizing a powder delivery system; 2. a supercritical fluid system; and 3. three vaporizers, one of which includes a liquid delivery system. The use of the plasma system will aid in the development of novel composite materials. The supercritical fluid system will be used to make nanoparticles from metal-organic compounds or noble metals. The different vaporizer systems will make it possible to use volatile solid or liquid precursors for deposition onto the surface of the nanoparticles. This coating technique is aimed at producing composite and/or magnetoresistive materials. Evaluation of the manual system controls are currently being accomplished. Computer control designs are well underway and being tested. Any information gathered during the manual control testing will be implemented into the computer control design.

## 26 METALLIC MATERIALS

*Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.*

**19990008548** NASA Ames Research Center, Moffett Field, CA USA

**Durable Advanced Flexible Reusable Surface Insulation**

Rasky, Daniel, Inventor, NASA Ames Research Center, USA; Kourtides, Demetrius A., Inventor, NASA Ames Research Center, USA; Dittman, Daniel L., Inventor, NASA Ames Research Center, USA; Rezin, Marc D., Inventor, NASA Ames Research Center, USA; Hiel, Clement, Inventor, NASA Ames Research Center, USA; Vallotton, Wilbur C., Inventor, NASA Ames Research Center, USA; Sep. 22, 1998; 16p; In English

Patent Info.: Filed 19 Jan. 1996; NASA-Case-ARC-12081-1CU; US-Patent-5,811,168; US-Patent-Appl-SN-598738; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An improved flexible blanket includes a nickel-based alloy foil layer brazed to a nickel-based alloy fabric layer. The fabric layer is stitched to an underlying ceramic insulation layer.

Official Gazette of the U.S. Patent and Trademark Office

*Insulation; Fabrics; Metal Foils*

**19990008594** NASA Lewis Research Center, Cleveland, OH USA

**Two-Phase (TiAl+TiCrAl) Coating Alloys for Titanium Aluminides**

Brady, Michael P., Inventor, NASA Lewis Research Center, USA; Smialek, James L., Inventor, NASA Lewis Research Center, USA; Brindley, William J., Inventor, NASA Lewis Research Center, USA; Nov. 17, 1998; 11p; In English

Patent Info.: Filed 3 Jul. 1996; NASA-Case-LEW-20003-1; US-Patent-5,837,387; US-Patent-Appl-SN-675126; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A coating for protecting titanium aluminide alloys, including the TiAl gamma + Ti3Al (alpha(sub 2)) class, from oxidative attack and interstitial embrittlement at temperatures up to at least 1000 C. is disclosed. This protective coating consists essentially of titanium, aluminum, and chromium in the following approximate atomic ratio: Ti(41.5-34.5)Al(49-53)Cr(9.5-12.5)

Official Gazette of the U.S. Patent and Trademark Office

*Aluminum Alloys; Titanium Aluminides; Protective Coatings; Intermetallics*

**19990008650** NASA Lewis Research Center, Cleveland, OH USA

**Determination of Yield in Inconel 718 for Axial-Torsional Loading at Temperatures up to 649 C**

Gil, Christopher M., Pennsylvania State Univ., USA; Lissenden, Cliff J., Pennsylvania State Univ., USA; Lerch, Bradley A., NASA Lewis Research Center, USA; Nov. 1998; 38p; In English

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA /TM-1998-208658; E-11380; NAS 1.15:208658; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental program has been implemented to determine small offset yield loci under axial-torsional loading at elevated temperatures. The nickel-base superalloy Inconel 718 (IN718) was chosen for study due to its common use in aeropulsion applications. Initial and subsequent yield loci were determined for solutioned IN718 at 23, 371, and 454 C and for aged (precipitation hardened) IN718 at 23 and 649 C. The shape of the initial yield loci for solutioned and aged IN718 agreed well with the von Mises prediction. However, in general, the centers of initial yield loci were eccentric to the origin due to a strength-differential (S-D) effect that increased with temperature. Subsequent yield loci exhibited anisotropic hardening in the form of translation and distortion of the locus. This work shows that it is possible to determine yield surfaces for metallic materials at temperatures up to at least 649 C using multiple probes of a single specimen. The experimental data is first-of-its-kind for a superalloy at these very high temperatures and will facilitate a better understanding of multiaxial material response, eventually leading to improved design tools for engine designers.

Author

*Heat Resistant Alloys; Inconel (Trademark); Torsion; Temperature Effects; Axial Loads; Strain Distribution; Yield Strength; High Temperature Environments*



**19990008657** Boeing Co., Rocketdyne Propulsion and Power, Canoga Park, CA USA

**A Size Effect on the Fatigue Crack Growth Rate Threshold of Alloy 718**

Garr, K. R., Boeing Co., USA; Hresko, G. C., III, Fracture Systems Research, USA; 1998; 18p; In English; Fatigue Crack Growth Thresholds, Endurance Limits and Design, 4 Nov. 1998, Norfolk, VA, USA; Sponsored by American Society for Testing and Materials, USA

Contract(s)/Grant(s): NAS8-40000; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fatigue crack growth rate (FCGR) tests were conducted on Alloy 718 in the solution annealed and aged condition at room temperature. In each test, the FCGR threshold was measured using the decreasing ( $\Delta K$ ) method. Initial testing was at two facilities, one of which used C(T) specimens with  $W = 127$  mm. Previous data at the other facility had been obtained with specimens with  $W = 50.8$  mm. A comparison of test results at  $R = 0.1$  showed that the threshold for the 127 mm specimen was considerably higher than that of the 50.8 mm specimen. A check showed that this difference was not due to a heat-to-heat or lab-to-lab variation. Additional tests were conducted on specimens with  $W = 25.4$  mm and at other  $R$  values. Data for the various specimens is presented along with parameters usually used to describe threshold behavior.

Author

*Crack Propagation; Fatigue (Materials); Fatigue Tests; Nickel Alloys*

**19990008711** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

**Hot Explosive Consolidation of Molybdenum-Titanium and Tungsten-Titanium Alloys Final Report, Jan. 1993 - Dec. 1995**

Keckes, Laszlo J., Army Research Lab., USA; Oct. 1998; 77p; In English

Contract(s)/Grant(s): Proj. 1L1-61102-A-H4-3

Report No.(s): AD-A355065; ARL-TR-1827; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A novel hot explosive compaction (HEC) technique has been applied to molybdenum (Mo)- and tungsten (W)-based titanium (Ti) alloys. The constituent precursor powders of the alloy billet were surrounded by an exothermic mixture, which, when ignited, released a large amount of heat via a self-propagating high-temperature synthesis (SHS) reaction. Heat from the SHS reaction diffused into the precursor powder bed, causing the interior temperature to rise above 1,500 C. When the powder bed became isothermal, it was consolidated to high density by pressure waves generated by the detonation of an explosive. The amount of explosive charge and the molar ratio of exothermic mixture to sample were adjusted to produce full-density molybdenum-titanium (Mo-Ti) and tungsten-titanium (W-Ti) alloys. The billets were sectioned and examined with scanning electron microscopy (SEM), energy dispersive x-ray spectroscopy (EDS), x-ray diffraction analysis (XRD), and microhardness measurements. In context of the fabrication process, the similarities and differences of the resultant product microstructures are discussed.

DTIC

*Consolidation; Molybdenum; Titanium Alloys; Tungsten Alloys*

**19990008738** Kagoshima Univ., Faculty of Engineering, Japan

**Increase in the Leaching Rate of Manganese Nodule by Iron Oxidizing Bacteria**

Kai, Takami, Kagoshima Univ., Japan; Taniguchi, Syusaku, Kagoshima Univ., Japan; Ikeda, Syuichi, Kagoshima Univ., Japan; Takahashi, Takeshige, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 58, pp. 61-65; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The deep-sea manganese nodule contains valuable elements such as Mn, Cu, Ni, and Co. In this study, the effect of iron oxidizing bacteria on the leaching of a manganese nodule was studied. Although the manganese nodule was not leached in a 0.01 N sulfuric acid solution, the extraction was increased by adding ferrous ion as a reducing agent. As the iron oxidizing bacteria can utilized ferrous ion is a substrate, the leaching of the manganese nodule was carried out in the presence of ferrous ion and the iron oxidizing bacteria. The results show that the extraction of a manganese nodule increased with the initial cell concentration. In the oxidative-reductive leaching of a manganese nodule and nickel sulfide, the leaching rates of these two materials increased. In addition, we also investigated the effect of the bacteria in oxidative-reductive leaching. The increase in the extraction was also observed in the bacterial leaching system.

Author

*Manganese; Leaching; Nodules; Iron; Oxidation; Bacteria*

**19990008858** NASA Lewis Research Center, Cleveland, OH USA

**Determination of Yield in Inconel 718 for Axial-Torsional Loading at Temperatures up to 649 C**

Gil, Christopher M., Pennsylvania State Univ., USA; Lissenden, Cliff J., Pennsylvania State Univ., USA; Lerch, Bradley A., NASA Lewis Research Center, USA; Nov. 1998; 36p; In English

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA/TM-1998-208658; NAS 1.15:208658; E-11380; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An experimental program has been implemented to determine small offset yield loci under axial-torsional loading at elevated temperatures. The nickel-base superalloy Inconel 718 (IN718) was chosen for study due to its common use in aeropropulsion applications. Initial and subsequent yield loci were determined for solutioned IN718 at 23, 371, and 454 C and for aged (precipitation hardened) IN718 at 23 and 649 C. The shape of the initial yield loci for solutioned and aged IN718 agreed well with the von Mises prediction. However, in general, the centers of initial yield loci were eccentric to the origin due to a strength-differential (S-D) effect that increased with temperature. Subsequent yield loci exhibited anisotropic hardening in the form of translation and distortion of the locus. This work shows that it is possible to determine yield surfaces for metallic materials at temperatures up to at least 649 C using multiple probes of a single specimen. The experimental data is first-of-its-kind for a superalloy at these very high temperatures and will facilitate a better understanding of multiaxial material response, eventually leading to improved design tools for engine designers.

Author

*Nickel Alloys; Aircraft Engines; Anisotropy; Heat Resistant Alloys; Torsion*

**19990008888** North Carolina State Univ., Mars Mission Research Center, Raleigh, NC USA

**Determination of Stress Coefficient Terms in Cracked Solids for Monoclinic Materials with Plane Symmetry at  $x_3 = 0$**

Yuan, F. G., North Carolina State Univ., USA; Oct. 1998; 36p; In English

Contract(s)/Grant(s): NAG1-1981; NAG1-548; RTOP 538-13-11-01

Report No.(s): NASA/CR-1998-208729; NAS 1.26:208729; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Determination of all the coefficients in the crack tip field expansion for monoclinic materials under two-dimensional deformation is presented in this report. For monoclinic materials with a plane of material symmetry at  $x_3 = 0$ , the in-plane deformation is decoupled from the anti-plane deformation. In the case of in-plane deformation, utilizing conservation laws of elasticity and Betti's reciprocal theorem, together with selected auxiliary fields, T-stress and third-order stress coefficients near the crack tip are evaluated first from path-independent line integrals. To determine the T-stress terms using the J-integral and Betti's reciprocal work theorem, auxiliary fields under a concentrated force and moment acting at the crack tip are used respectively. Through the use of Stroh formalism in anisotropic elasticity, analytical expressions for all the coefficients including the stress intensity factors are derived in a compact form that has surprisingly simple structure in terms of the Barnett-Lothe tensors,  $L$ . The solution forms for degenerated materials, orthotropic, and isotropic materials are presented.

Author

*Anisotropy; Conservation Laws; Crack Tips; Deformation; Elastic Properties; J Integral; Stress Analysis; Stress Intensity Factors*

**19990008908** Virginia Univ., Intelligent Processing of Materials Lab., Charlottesville, VA USA

**A Review of the Intelligent Processing of Materials and a Case Study of Titanium Matrix Composite Consolidation**

Wadley, Haydn N. G., Virginia Univ., USA; Vancheeswaran, R., Virginia Univ., USA; Nov. 1998; 14p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

The recent emergence of a general Intelligent Processing of Materials (IPM) methodology that combines mathematical modeling of processes, novel material composition/microstructure sensing and model predictive control for synthesizing high performance materials is reviewed. To illustrate its application, the IPM approach is applied to the consolidation of fiber reinforced metal matrix composites. The consolidation process seeks to eliminate matrix porosity while minimizing fiber microbending/fracture and the growth of reaction products at the fiber-matrix interface. By combining a model predictive process path planning concept with time dependent consolidation models, a method could be devised for optimal design of process schedules that evolve performance defining microstructural parameters of the composite (i.e. relative density, fiber fracture density and fiber-matrix reaction thickness) to pre-determined goal states resulting in composites of a desired mechanical performance. In the real world, the input material parameters used for the model are always stochastically distributed. This variability in the material parameters is shown to significantly affect the final microstructural states resulting in sometimes large reductions in the yield of the goal state material, even when the optimal process is used. By combining in-situ sensors that measure relative density and fiber fracture with model-based predictions of future evolution of the microstructural states, on-line control of the process inputs to drive the uncertain

plant's microstructure to the desired goal state is shown to be possible. This increases process yield and can force process failures to only occur in ways that are easily inspected for after processing.

Author

*Process Control (Industry); Metal Matrix Composites; Fiber Composites; Computerized Simulation; Microstructure; Stochastic Processes; Smart Materials; Titanium; Computer Aided Manufacturing*

**19990008914** Air Force Research Lab., Materials and Manufacturing Directorate, Wright-Patterson AFB, OH USA

**Intelligent Control Strategies for Metal Forging Processes**

Malas, J. C., Air Force Research Lab., USA; Frazier, W. G., Air Force Research Lab., USA; Nov. 1998; 10p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Advanced process design and intelligent control methods are needed for significant improvements in metalworking processes such as forging. Some of the distinguishing aspects of forging processes which present formidable challenges to employing intelligent control strategies are the lack of sensors for real-time measurement of the variables to be controlled; limited dynamic actuation for sufficient control authority; and development of efficient models for control system design. Also, in press forging there is basically only one dynamic control parameter which is ram velocity; but there are multiple static control parameters such as initial workpiece temperature, die temperature, preform shape, and die geometry. The existing models for high fidelity analysis of gross plastic deformation processes are too computationally intensive for practical design and real-time control. A suitable architecture of a intelligent material processing system for multi-step thermomechanical processes is proposed. The components of the IPM framework include: open-loop process design, feedback compensation, feedforward compensation, and learning and adaptation systems. Some recent progress in dynamic modeling and optimal design techniques for workpiece material behavior, material flow in dies, and equipment responses are discussed. Illustrative simulation examples showing feedback compensation in disk forging process and feedforward compensation for microstructure control demonstrate potential benefits of intelligent control strategies.

Author

*Process Control (Industry); Control Systems Design; Computer Aided Manufacturing; Artificial Intelligence; Forging; Smart Materials; Metal Working; Dynamic Control; Feedforward Control*

**19990008916** Birmingham Univ., IRC in Materials for High Performance Applications, UK

**Process Modelling and Control for Cold Hearth Refining of Intermetallic Alloys**

Ward, R. M., Birmingham Univ., UK; Johnson, T. P., Birmingham Univ., UK; Young, J. M., Birmingham Univ., UK; Intelligent Processing of High Performance Materials; Nov. 1998; 6p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Manufacturing processes can be tailored to a specific product using empirical knowledge. Such knowledge is not necessarily generic, which means that it may be difficult to respond to changes in market requirements. Empirical knowledge, while extremely valuable, may also not be enough to suggest changes to the processing route which could increase quality. Process modelling can provide a deeper level of understanding of the influence of process parameters on product quality, in a form which can be more easily transferred to new manufacturing situations. In particular, process modelling can highlight strategies for process control and identify necessary sensors. These ideas can be applied to the cold hearth melting process. Relationships between the goals of the process, process modelling, sensing and control will be discussed in the light of the challenges which the cold hearth melting of titanium alloys presents.

Author

*Process Control (Industry); Manufacturing; Mathematical Models; Titanium Alloys; Intermetallics; Hearths; Refining; Melting*

**19990008917** National Research Council of Canada, Industrial Materials Inst., Boucherville, Quebec Canada

**Laser Ultrasonic Measurement of Microstructure Evolution During Metals Processing**

Dubois, Marc, National Research Council of Canada, Canada; Moreau, Andre, National Research Council of Canada, Canada; Militzer, Matthias, British Columbia Univ., Canada; Bussiere, Jean F., National Research Council of Canada, Canada; Nov. 1998; 10p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

Laser-ultrasonics, a technique based on the generation of ultrasonic waves by a pulsed laser and on their detection by a laser interferometer, was used to monitor microstructure evolution during austenitization and phase transformations of A36 and IF steels, and during the sintering of a green powder metal iron compact. Ultrasonic attenuation measurements allowed the observation of grain growth during austenitization and of nucleation and growth during phase transformations. A calibration based on the metallographic evaluation of austenite grain sizes on quenched steel samples was obtained to quantitatively relate ultrasonic attenuation to austenite grain sizes. Ultrasonic velocity measurements also allowed the monitoring of the first two stages of the

sintering process in a green powder metal iron compact. The laser-ultrasonic technique provided, in real-time, microstructural information that could only have been obtained laboriously using traditional metallographic techniques. The results presented in this paper establish laser-ultrasonics as a powerful laboratory tool to study microstructural evolution at high temperatures.

Author

*Process Control (Industry); Manufacturing; Microstructure; Interferometers; Austenite; Phase Transformations; Real Time Operation; Velocity Measurement; Steels; Ultrasonics; Metal Powder; Laser Applications*

**19990008918** Ecole des Mines, Lab. de Science et Genie des Materiaux Metalliques, Nancy, France

**Modelling of Ti Alloy Melting by EBCHM: Impact of Process Parameters for Hard-Alpha Dissolution**

Bellot, J. P., Ecole des Mines, France; Jardy, A., Ecole des Mines, France; Bourguignon, S., Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, France; Ablitzer, D., Ecole des Mines, France; Nov. 1998; 8p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The random occurrence of the hard-alpha defect in rotating part used for aero-engines has been one of the main materials problems in the manufacture of quality titanium alloys for some time. The Electron Beam Cold Hearth Melting (EBCHM) process has shown a great promise in being able to refine Ti alloys and to eliminate hard-alpha inclusions by dissolution or settling. A research programme has been launched, with the aim of specifying the remelting process parameters required for the elimination of the defect. Hence the mathematical model of the refining step of the EBCHR process has been developed at the Nancy School of Mines. The model allows calculation of the maps of the velocity, turbulence intensity, temperature and chemical composition in the cold hearth. An experimental and theoretical studies of the hard-alpha defect behaviour in liquid titanium have been carried out. The experimental part of the work consists in immersing of synthetic defect into a titanium liquid bath for a known length of time and analysing it by microprobe after the experiment. In parallel, a kinetic model of dissolution, which computes the transient diffusion of the interstitial solute with alpha and beta intermediate phases, has been developed. In order to predict the potential removal of this kind of defect during the remelting operation, the calculation of the particle trajectory and the kinetic model of dissolution have been coupled. It allows the simulation of the history of the defect in terms of positions and shrinkage or growth of the particle in the metal liquid bath. Results for different process parameters are presented and discussed.

Author

*Process Control (Industry); Computer Aided Manufacturing; Aircraft Engines; Engine Parts; Microanalysis; Mathematical Models; Hearths; Melting; Defects; Titanium Alloys; Refining*

**19990008955** Electroformed Nickel, Inc., Huntsville, AL USA

**Improved Electroformed Structural Copper and Copper Alloys Final Report**

Malone, G. A., Electroformed Nickel, Inc., USA; Hudson, W., Electroformed Nickel, Inc., USA; Babcock, B., Electroformed Nickel, Inc., USA; Edwards, R., Electroformed Nickel, Inc., USA; Nov. 1998; 170p; In English

Contract(s)/Grant(s): NAS3-27386; RTOP 244-02-01

Report No.(s): NASA/CR-1998-208680; NAS 1.26:208680; E-11417; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Electroforming offers a superior means for fabricating internally cooled heat exchangers and structures subjected to thermal environments. Copper is deposited from many such applications because of the good thermal conductivity. It suffers from mediocre yield strength as a structural material and loses mechanical strength at intermediate temperatures. Mechanical properties similar to those of electroformed nickel are desired. Phase 1 examined innovative means to improve deposited copper structural performance. Yield strengths as high as 483 MPa (70 ksi) were obtained with useful ductility while retaining a high level of purity essential to good thermal conductivity. Phase 2 represents a program to explore new additive combinations in copper electrolytes to produce a more fine, equiaxed grain which can be thermally stabilized by other techniques such as alloying in modest degrees and dispersion strengthening. Evaluation of new technology - such as the codeposition of fullness (diamond-like) particles were made to enhance thermal conductivity in low alloys. A test fire quality tube-bundle engine was fabricated using these copper property improvement concepts to show the superiority of the new coppers and fabrications methods over competitive technologies such as brazing and plasma deposition.

Author

*Electroforming; Copper Alloys; Thermal Environments; Thermal Conductivity; Electrolytes; Dispersion Strengthening*



**19990008984** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Electrodeposition of Amorphous Cr-Ni Alloys from 50vol%-Dimethyl Formamide Solutions**

Tsuru, Toshiaki, Kyushu Sangyo Univ., Japan; Kobayashi, Shigeo, Kyushu Sangyo Univ., Japan; Koga, Michio, Kyushu Sangyo Univ., Japan; Yamasaki, Sumio, Kyushu Sangyo Univ., Japan; Yanagase, Tsutomu, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 155-157; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Cr-Ni amorphous alloy films were deposited from 50vol% of dimethyl formamide solution principally composed of Ni and Cr(III) chlorides. The structure of the Cr-Ni alloy film changed with changes in plating current density and molar ratio of Cr/Ni in solutions. Moreover, in wide range of higher current densities, Cr content of alloy films was found to be always higher than the corresponding metal ratio in the bath. These results exhibited the anomalous type - codeposition. X-ray diffraction data showed that films containing about 80wt% Cr consisted of amorphous alloy film and with an increase in Cr content, the structure became microcrystalline and amorphous.

Author

*Electrodeposition; Amorphous Materials; Metal Films; Chromium Alloys; Nickel Alloys*

**19990009002** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Deuteration of Bromophenol Derivatives with Cu-Al Alloy in a D2O Solution of Sodium Carbonate or Barium Oxide**

Kakinami, Takaaki, Ube National Coll. of Technology, Japan; Iida, Yukiko, Ube National Coll. of Technology, Japan; Kajigaeshi, Shoji, Yamaguchi Univ., Japan; Eguchi, Hisao, Tosoh Ltd., Japan; Tashiro, Masashi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 41-43; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The reductive debromination of bromophenol derivatives and 1-bromonaphthalene-2-ol with Cu-Al alloy in a D2O solution of sodium carbonate or barium oxide at 60 C under a nitrogen atmosphere gives ring-deuteriated phenol derivatives and 1-deuterionaphthalene-2-ol, respectively, in good yields and in high isotopic purities.

Author

*Aluminum Alloys; Copper Alloys; Sodium Carbonates; Barium Oxides; Phenols; Bromine Compounds; Heavy Water; Reduction (Chemistry)*

**19990009088** National Defence Research Establishment, Div. of Guidance and Control, Materials and Underwater Sensors, Stockholm, Sweden

**Constitutive Relations for Metals at High Strain Rates *Konstitutiva Ekvationer foer Metaller vid Hoega Toejningshastighet-er***

Bratt, C., National Defence Research Establishment, Sweden; Jan. 1998; 30p; In Swedish

Report No.(s): PB99-108714; FOA-R-98-00711-318-SE; No Copyright; Avail: Issuing Activity (Nat'l Technical Information Service (NTIS)), Microfiche

This report gives an overview for four constitutive relations at high strain rates for metals. These relations are used for simulation of penetration. For two of the relations, a method for determination of the constants are given. These two relations are Johnson and Cook and Zerilli and Armstrong. The report concludes with some experience from using these methods.

NTIS

*Strain Rate; Metals*

## 27

### NONMETALLIC MATERIALS

*Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.*

**19990008478** Tennessee Univ., Center for Clean Products and Clean Technologies, Knoxville, TN USA

**Demonstration of Packaging Materials Alternatives to Expanded Polystyrene *Final Report***

Menke, D. M., Tennessee Univ., USA; Apr. 1998; 116p; In English

Contract(s)/Grant(s): EPA-CR-821848-01-0

Report No.(s): PB99-104705; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The report presents information on the environmental, economical, and performance characteristics of alternative packaging materials. Three 'alternative' cushioning materials were identified for evaluation within this research; starch-based foam planks,

layered corrugated pads, and recycled polyethylene foam. Through some have been used as cushioning materials for some time, these materials are termed 'alternative' because each offers unique features beyond their cushioning capabilities. These unique features include their manufacture from recycled materials, biodegradability, water solubility, recyclability, and reusability. The properties and cushioning characteristics of expanded polystyrene (EPS) represent the baseline for this research; evaluation results for each material are compared against those of EPS. Technical, environmental, and economic evaluations were completed to assess various characteristics and parameters concerning the cushioning materials.

NTIS

*Polystyrene; Packaging; Recycling; Cost Reduction; Economics*

**19990008543** NASA Ames Research Center, Moffett Field, CA USA

**Organopolysiloxane Waterproofing Treatment for Porous Ceramics**

Leiser, Daniel B., Inventor, NASA Ames Research Center, USA; Cagliostro, Domenick E., Inventor, NASA Ames Research Center, USA; Hsu, Ming-ta S., Inventor, NASA Ames Research Center, USA; Chen, Timothy S., Inventor, NASA Ames Research Center, USA; Jun. 16, 1998; 6p; In English

Patent Info.: Filed 30 Oct. 1996; NASA-Case-ARC-14068-1-SB; US-Patent-5,766,322; US-Patent-Appl-SN-745405; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

Rigid and flexible porous ceramics, including thermal insulation of a type used on space vehicles, are waterproofed by a treatment which comprises applying an aqueous solution of an organopolysiloxane water-proofing agent having reactive silanol groups to the surface of the ceramic and then heating the treated ceramic to form a waterproofed ceramic. The organopolysiloxane is formed by the hydrolysis and partial condensation of di- and trialkoxyfunctional alkylalkoxysilanes having 1-10 carbon atom hydrocarbyl groups.

Official Gazette of the U.S. Patent and Trademark Office

*Ceramics; Organic Silicon Compounds; Porous Materials; Waterproofing; Protective Coatings*

**19990008546** NASA Ames Research Center, Moffett Field, CA USA

**Method for Waterproofing Ceramic Materials**

Cagliostro, Domenick E., Inventor, NASA Ames Research Center, USA; Hsu, Ming-Ta S., Inventor, NASA Ames Research Center, USA; Sep. 29, 1998; 8p; In English

Patent Info.: Filed 13 Sep. 1995; NASA-Case-ARC-14029-1-SB; US-Patent-5,814,397; US-Patent-Appl-SN-537585; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

Hygroscopic ceramic materials which are difficult to waterproof with a silane, substituted silane or silazane waterproofing agent, such as an alumina containing fibrous, flexible and porous, fibrous ceramic insulation used on a reentry space vehicle, are rendered easy to waterproof if the interior porous surface of the ceramic is first coated with a thin coating of silica. The silica coating is achieved by coating the interior surface of the ceramic with a silica precursor converting the precursor to silica either in-situ or by oxidative pyrolysis and then applying the waterproofing agent to the silica coated ceramic. The silica precursor comprises almost any suitable silicon containing material such as a silane, silicone, siloxane, silazane and the like applied by solution, vapor deposition and the like. If the waterproofing is removed by e.g., burning, the silica remains and the ceramic is easily rewaterproofed. An alumina containing TABI insulation which absorbs more than five times its weight of water, absorbs less than 10 wt. % water after being waterproofed according to the method of the invention.

Official Gazette of the U.S. Patent and Trademark Office

*Technology Assessment; Ceramics; Coatings; Insulation; Pyrolysis; Silanes; Silicon; Waterproofing*

**19990008575** NASA Johnson Space Center, Houston, TX USA

**Microcapsules and Methods for Making**

Morrison, Dennis R., Inventor, NASA Johnson Space Center, USA; Mosier, Benjamin, Inventor, NASA Johnson Space Center, USA; Oct. 27, 1998; 26p; In English

Patent Info.: Filed 2 Dec. 1994; NASA-Case-MS-C-22489-1; US-Patent-5,827,531; US-Patent-Appl-SN-349169; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

Methods of forming multi-lamellar microcapsules having alternating layers of hydrophilic and hydrophobic immiscible liquid phases have been developed using different polymer/solvent systems. The methods use liquid-liquid diffusion and simultaneous lateral phase separation, controlled by proper timed-sequence exposures of immiscible phases and low shear mixing, to form narrow size distributions of spherical, multilamellar microcapsules. The use of special formulations of solubilized drugs, surfactants, and polymeric co-surfactants in aqueous vehicles which are dispersed in hydrocarbon solvents containing small quantities of oil, low molecular weight co-surfactants and glycerides that are aqueous insoluble enables the formation of unique micro-

capsules which can carry large amounts of pharmaceuticals in both aqueous and non-aqueous solvent compartments. The liquid microcapsules are quickly formed in a single step and can include a polymeric outer 'skin' which protects the microcapsules during physical manipulation or exposure to high shear forces. Water-in-oil and oil-in-water microcapsules have been formed both in 1 x g and in microgravity, which contain several types of drugs co-encapsulated within different fluid compartments inside the same microcapsule. Large, spherical multi-lamellar microcapsules have been formed including a cytotoxic drug co-encapsulated with a radiocontrast medium which has advantages for chemoembolization of vascular tumors. In certain cases, crystals of the drug form inside the microcapsules providing zero-order and first order, sustained drug release kinetics.

Official Gazette of the U.S. Patent and Trademark Office

*Toxins and Antitoxins; Hydrocarbons; Glycerides; Microgravity; Kinetics; Liquid Phases*

**19990008579** NASA Langley Research Center, Hampton, VA USA

**Method for Molding Structural Parts Utilizing Modified Silicone Rubber**

Weiser, Erik S., Inventor, NASA Langley Research Center, USA; Baucom, Robert M., Inventor, NASA Langley Research Center, USA; Snoha, John J., Inventor, NASA Langley Research Center, USA; Sep. 29, 1998; 6p; In English; Continuation-in-part of abandoned US-Patent-Appl-SN-292621, filed 12 Aug. 1994

Patent Info.: Filed 25 Mar. 1997; NASA-Case-LAR-15217-2; US-Patent-5,814,259; US-Patent-Appl-SN-824097; US-Patent-Appl-SN-292621; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

This invention improves upon a method for molding structural parts from preform material. Preform material to be used for the part is provided. A silicone rubber composition containing entrained air voids is prepared. The silicone rubber and preform material assembly is situated within a rigid mold cavity used to shape the preform material to die desired shape. The entire assembly is heated in a standard heating device so that the thermal expansion of the silicone rubber exerts the pressure necessary to force the preform material into contact with the mold container. The introduction of discrete air voids into the silicone rubber allows for accurately controlled pressure application on the preform material at the cure temperature.

Official Gazette of the U.S. Patent and Trademark Office

*Procedures; Molding Materials; Structural Members; Silicone Rubber*

**19990008603** NASA Ames Research Center, Moffett Field, CA USA

**Ablation Resistant Zirconium and Hafnium Ceramics**

Bull, Jeffrey, Inventor, NASA Ames Research Center, USA; White, Michael J., Inventor, NASA Ames Research Center, USA; Kaufman, Larry, Inventor, NASA Ames Research Center, USA; May 12, 1998; 8p; In English

Patent Info.: Filed 30 Sep. 1996; NASA-Case-ARC-12087-1LE; US-Patent-5,750,450; US-Patent-Appl-SN-723484; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

High temperature ablation resistant ceramic composites have been made. These ceramics are composites of zirconium dioxide and zirconium carbide with silicon carbide, hafnium diboride and hafnium carbide with silicon carbide and ceramic composites which contain mixed diborides and/or carbides of zirconium and hafnium. along with silicon carbide.

Author

*Ablation; Zirconium; Hafnium; Zirconium Carbides; Hafnium Carbides; Ceramic Matrix Composites; Silicon Carbides*

**19990008609** NASA Langley Research Center, Hampton, VA USA

**Polyimide Fibers**

St.Clair, Terry L., Inventor, NASA Langley Research Center, USA; Fay, Catharine C., Inventor, NASA Langley Research Center, USA; Working, Dennis C., Inventor, NASA Langley Research Center, USA; Nov. 24, 1998; 4p; In English

Patent Info.: Filed 7 May 1997; NASA-Case-LAR-15556-2; US-Patent-5,840,828; US-Patent-Appl-SN-858201; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A polyimide fiber having textile physical property characteristics and the process of melt extruding same from a polyimide powder. Polyimide powder formed as the reaction product of the monomers 3,4'-ODA and ODA, and end-capped with phthalic anhydride to control the molecular weight thereof, is melt extruded in the temperature range of 340 C. to 360 C. and at heights of 100.5 inches, 209 inches and 364.5 inches. The fibers obtained have a diameter in the range of 0.0068 inch to 0.0147 inch; a mean tensile strength in the range of 15.6 to 23.1 ksi; a mean modulus of 406 to 465 ksi, and a mean elongation in the range of 14 to 103%.

Official Gazette of the U.S. Patent and Trademark Office

*Polyimides; Fiber Composites; Fibers; Molecular Weight; Extruding*



**19990008646** California Univ., Dept. of Materials Science and Engineering, Los Angeles, CA USA

**Anionic Conducting Oxide Ceramics Final Report, 15 Apr. 1995 - 14 Apr. 1998**

Dunn, Bruce, California Univ., USA; Mackenzie, John D., California Univ., USA; Apr. 1998; 10p; In English  
Contract(s)/Grant(s): F49620-95-1-0175

Report No.(s): AD-A355211; AFRL-SR-BL-TR-98-0678; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This program has emphasized the interrelationships among synthesis, microstructure and properties for oxygen ion conducting ceramics based on copper-substituted bismuth vanadate ( $\text{Bi V Cu O}$ ), known as BICUVOX. We showed that these materials readily formed dense ceramics with equiaxed microstructures and confirmed that they exhibited high ionic conductivity. Prolonged heat treatments at elevated temperatures did not cause significant changes in conductivity, an important consideration for electrochemical device operation. We also developed solution processing approaches for preparing thin films of the bismuth vanadate materials.

DTIC

*Oxides; Anions; Bismuth; Vanadates; Synthesis (Chemistry); Electrical Resistivity; Ceramics; Ion Currents*

**19990008737** Kagoshima Univ., Faculty of Engineering, Japan

**A Fundamental Study of Adsorption of Nickel and Cobalt-Ethylenediamine Complex Ion on Porous Glass**

Fujiyoshi, Issei, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 58, pp. 67-70; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experiment of the adsorption of nickel and cobalt in a solution of ethylenediamine on granular porous glass showed that bis-ethylenediamine complexes of these metals were adsorbed by a ligand substitution and that cobalt was adsorbed more than nickel because the stability constant of a cobalt complex is small. The experiment of the adsorption of ethylenediamine demonstrated that the molecular ratio of released proton and adsorbed ethylenediamine was 2 : 1, also showing the adsorption of divalent ethylenediamine ion by an ion exchange.

Author

*Nickel; Adsorption; Cobalt; Ethylenediamine; Glass; Porosity*

**19990008740** Kagoshima Univ., Faculty of Engineering, Japan

**Preparation of Copolymer Microsphere Prepared from Liquid Crystal Monomer/Styrene by Emulsion Polymerization and Suspension Polymerization**

Hatate, Yasuo, Kagoshima Univ., Japan; Hamasaki, Kazunari, Kagoshima Univ., Japan; Fukumoto, Koji, Kagoshima Univ., Japan; Uemura, Yoshimitsu, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 35, pp. 47-52; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A vinyl monomer having a long chain methylene and biphenyl was synthesized as a liquid crystal monomer. Emulsion polymerization and suspension polymerization were carried out to obtain copolymer microspheres using liquid crystal monomer and styrene monomer. Seven kinds of copolymers, having various liquid crystal monomer segment contents, were obtained by emulsion polymerization. By suspension polymerization, a homopolymer was obtained using the liquid crystal monomer. The physical properties of the copolymers and the homopolymers were measured by Scanning Electron Microscopy (SEM), Differential Scanning Calorimetry (DSC), and polarized light transmittance.

Author

*Copolymers; Microparticles; Liquid Crystals; Monomers; Styrenes; Emulsions; Polymerization*

**19990008809** Kagoshima Univ., Faculty of Engineering, Japan

**Effect of Surface Morphology on Electrostatic Property of Polymer Microsphere**

Hatate, Yasuo, Kagoshima Univ., Japan; Higo, Shinichi, Kagoshima Univ., Japan; Uemura, Yoshimitsu, Kagoshima Univ., Japan; Kawano, Yoshinobu, Kagoshima Univ., Japan; Ide, Shunsuke, Kagoshima Univ., Japan; Hatanaka, Chiaki, Kagoshima Univ., Japan; Haraguchi, Toshinobu, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 35, pp. 39-45; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Styrene-divinylbenzene copolymer microspheres of ca. 100 micrometers in diameter were prepared by suspension polymerization in order to investigate the dependence of electrostatic properties on surface morphology. Surface morphology was changed varying the pore distribution and the average size of pores in microspheres. That is, the different types of diluent, toluene and n-dodecane, were used to change the surface morphology. The pore size using n-dodecane became larger than that using toluene. The electrostatic capacities obtained in the n-dodecane system were of higher values than those in the toluene system. In the case

where the mixtures of n-dodecane and toluene were used as the diluent, the highest value for the electrostatic capacity was obtained when the solution (n-dodecane: toluene=1 : 1 in volume ratio) was used.

Author

*Polymerization; Surface Properties; Electrostatics; Morphology; Microparticles*

**19990008827** United Space Boosters, Inc., Cocoa Beach, FL USA

**Development of a Convergent Spray Technologies(tm) Spray Process for a Solventless Sprayable Coating, MCC-1**

Patel, Anil K., United Space Boosters, Inc., USA; Meeks, C., United Space Boosters, Inc., USA; 1998; 7p; In English; Technology 2008, 3-5 Nov. 1998, Boston, MA, USA; Sponsored by NASA, USA

Contract(s)/Grant(s): NAS8-36300; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper discusses the application of Convergent Spray Technologies (TM) Spray Process to the development and successful implementation of Marshall Convergent Coating (MCC-1) as a primary Thermal Protection System (TPS) for the Space Shuttle Solid Rocket Boosters (SRBs). This paper discusses the environmental and process benefits of the MCC-1 technology, shows the systematic steps taken in developing the technology, including statistical sensitivity studies of about 35 variables. Based on the process and post-flight successes on the SRB, it will be seen that the technology is "field-proven". Application of this technology to other aerospace and commercial programs is summarized to illustrate the wide range of possibilities.

Author

*Sprayers; Technology Assessment; Coating*

**19990008851** Federal Aviation Administration, Fire Safety Section, Atlantic City, NJ USA

**Heats of Combustion of High-Temperature Polymers**

Lyon, Richard E., Federal Aviation Administration, USA; Hackett, Stacey M., Federal Aviation Administration, USA; Walters, Richard N., Galaxy Scientific Corp., USA; Sep. 1998; 24p; In English

Report No.(s): PB99-105835; DOT/FAA/AR-TN97/8; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The heats of combustion for 47 commercial and developmental polymers of known chemical structure were determined using an oxygen bomb calorimeter according to standard methods. The experimental results were compared to thermochemical calculations of the gross heat of combustion from (1) oxygen consumption and (2) group additivity of the heats of formation of products and reactants. The polymers examined were thermally stable, char-forming thermoplastics and thermoset resins containing a significant degree of aromaticity and heteroatoms including nitrogen, sulfur, phosphorus, silicon, and oxygen in linear and heterocyclic structures. The gross heats of combustion calculated from polymer enthalpies of formation and oxygen consumption thermochemistry were within 4 and 5 percent, respectively, of the experimental values from oxygen bomb calorimetry.

NTIS

*Heat of Combustion; High Temperature; Thermochemistry*

**19990008861** NASA Lewis Research Center, Cleveland, OH USA

**Synchrotron VUV and Soft X-Ray Radiation Effects on Aluminized Teflon FEP**

Dever, Joyce A., NASA Lewis Research Center, USA; Townsend, Jacqueline A., NASA Goddard Space Flight Center, USA; Gaiser, James R., NASA Lewis Research Center, USA; Jalics, Alice I., Cleveland State Univ., USA; Nov. 1998; 12p; In English; 43rd, 31 May - 4 Jun. 1998, Anaheim, CA, USA; Sponsored by Society for Advancement of Materials and Process Engineering, USA Contract(s)/Grant(s): RTOP 632-1A-1E

Report No.(s): NASA/TM-1998-208828; NAS 1.15:208828; E-11439; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Surfaces of the aluminized Teflon FEP multi-layer thermal insulation on the Hubble Space Telescope (HST) were found to be cracked and curled in some areas at the time of the second servicing, mission in February 1997, 6.8 years after HST was deployed in low Earth orbit (LEO). As part of a test program to assess environmental conditions which would produce embrittlement sufficient to cause cracking of Teflon on HST, samples of Teflon FEP with a backside layer of vapor deposited aluminum were exposed to vacuum ultraviolet (VUV) and soft x-ray radiation of various energies using facilities at the National Synchrotron Light Source, Brookhaven National Laboratory. Samples were exposed to synchrotron radiation of narrow energy bands centered on energies between 69 eV and 1900 eV. Samples were analyzed for ultimate tensile strength and elongation. Results will be compared to those of aluminized Teflon FEP retrieved from HST after 3.6 years and 6.8 years on orbit and will be referenced to estimated HST mission doses of VUV and soft x-ray radiation.

Author

*Hubble Space Telescope; Teflon (Trademark); Tensile Strength; Thermal Insulation; Synchrotrons; Synchrotron Radiation; Radiation Effects; Multilayer Insulation*

**19990008909** Akzo Nobel Central Research B.V., Dept. Applied Fiber Physics, Arnhem, Netherlands

**Process-Structure-Property Relationships Obtained with Natural Computation**

deWeijer, Ton, Akzo Nobel Central Research B.V., Netherlands; Intelligent Processing of High Performance Materials; Nov. 1998; 10p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The development of high performance yarns with properties that closely match the requirements of customers requires a detailed insight into the influences of process variations and structure arrangements on yarn properties. To obtain these relationships, use has been made of computation techniques whose basic principles are adopted from nature. These so-called natural computation methods have unique problem solving possibilities. The relationships between process settings, physical molecular structure and (thermo)mechanical properties of poly(ethylene terephthalate) yarns were determined by Artificial Neural Networks (ANNs). Although the internal structure of ANNs is incomprehensive with respect to the mechanisms of the modeled relations, it is a fast and accurate way to make data and relations between data-sets easily accessible. From an effective process and product development point-of-view, it is interesting to be able to apply the relations that have been modeled with ANNs in a reverse way, i.e. to find possible structures or process settings resulting in a certain combination of desired properties. SYNGA was developed to realize this. It consists of a genetic algorithm in which an artificial neural network is embedded and serves as the 'knowledge-base' for the optimization procedure. The trained and validated ANNs, genetic algorithms and background knowledge in the form of texts and figures are implemented in a user-friendly software system called BESSY. In this way, knowledge concerning the relations between process conditions, physical structure and end-use properties of PET yarns are made accessible to other scientists.

Author

*Process Control (Industry); Artificial Intelligence; Computer Aided Manufacturing; Genetic Algorithms; Neural Nets; Computer Programs; Expert Systems*

**19990008919** NASA Langley Research Center, Hampton, VA USA

**Automated Fabrication Technologies for High Performance Polymer Composites**

Shuart, M. J., NASA Langley Research Center, USA; Johnston, N. J., NASA Langley Research Center, USA; Dexter, H. B., NASA Langley Research Center, USA; Marchello, J. M., Old Dominion Univ., USA; Grenoble, R. W., Old Dominion Univ., USA; Nov. 1998; 12p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

New fabrication technologies are being exploited for building high performance graphite-fiber-reinforced composite structure. Stitched fiber preforms and resin film infusion have been successfully demonstrated for large, composite wing structures. Other automate processes being developed include automated placement of tacky, drapable epoxy towpreg, automated heated head placement of consolidated ribbon/tape, and vacuum-assisted resin transfer molding. These methods have the potential to yield low cost, high performance structures by fabricating composite structures to net shape out-of-autoclave.

Author

*Process Control (Industry); Manufacturing; Wings; Composite Structures; Resin Film Infusion; Automatic Control; Graphite-Epoxy Composites; Polymer Matrix Composites*

**19990008920** Defence Evaluation Research Agency, Farnborough, UK

**Remote Cure Sensing of Polymer Composites**

Pullen, D. A., Defence Evaluation Research Agency, UK; Attwood, D., British Aerospace Aircraft Group, UK; Partridge, I., Cranfield Univ., UK; Batchelor, M., British Aerospace Aircraft Group, UK; Cracknell, G., Shorts Brothers, UK; Nov. 1998; 12p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

Cure monitoring of polymer composites has been investigated for many years, but there is still not a fully interactive system control available in the marketplace which can provide, in real-time, a direct measure of the chemical and physical state of the matrix resin throughout the whole cure. The potential of such a system to aid improved cost effective manufacturing is still a strong driving force for its development to be justified. This paper describes work which endeavoured to critically review and further develop aspects of such a system and provide a realistic assessment of future efforts required for its realisation.

Author

*Process Control (Industry); Manufacturing; Interactive Control; Real Time Operation; Remote Sensing; Resin Matrix Composites; Curing*

**19990008921** Cranfield Univ., Bedford, UK

**Process Control of Deposition Profiles in the Manufacture of EB-PVD Thermal Barrier Coatings**

Nicholls, J. R., Cranfield Univ., UK; Pereira, V., Cranfield Univ., UK; Lawson, K. J., Cranfield Univ., UK; Rickerby, D. S., Rolls-Royce Ltd., UK; Nov. 1998; 12p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

For many applications of coatings it is often undesirable to have a uniform coating thickness around a component. Thermal barrier coatings on aerofoil components are a particular example where a uniform coating distribution around the blade or van would degrade aerodynamic performance. It is desirable therefore to limit the thickness of such coatings on the trailing edge of such components. This paper describes the development of process control models capable of predicting both the deposition rate and column inclination during the deposition of EB-PVD thermal barrier coatings. Thus by programming the rate of rotation and absolute position of blades to be coated relative to the evaporation source it should be possible to predict coating geometries on complex hardware.

Author

*Process Control (Industry); Computer Aided Manufacturing; Airfoils; Thermal Control Coatings; Vacuum Deposition*

**19990008922** NASA Lewis Research Center, Cleveland, OH USA

**Laser Heated Oxide Fiber Growth Using Melt Modulation Technique**

Sayir, Ali, NASA Lewis Research Center, USA; Farmer, Serene C., NASA Lewis Research Center, USA; Dickerson, Pat, Case Western Reserve Univ., USA; Chait, Arnon, NASA Lewis Research Center, USA; Nov. 1998; 17p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A03, Hardcopy; A02, Microfiche

As a reinforcement for structural composites, single crystal alumina fibers offer low density, high modulus, and high creep resistance. In this study, the laser heated float zone approach was employed to grow c-axis Al<sub>2</sub>O<sub>3</sub> continuous fibers of high purity and high strength. A new melt modulation technique, laser scanning, avoids the formation of surface induced ripples and allows the growth of 50 micro-m diameter sapphire fibers with strengths (approx. 7 GPa) significantly greater than either commercially available fibers grown by the edge-defined film growth process (approx. 2-3 GPa) or laboratory fibers grown by stationary laser heating (approx. 5 GPa). The present work suggests that surface striations are the predominant defects controlling the tensile strength of laser-scanned fibers at room temperature. Several possible mechanisms for inducing surface striations are systematically discussed for several oxide fiber compositions.

Author

*Process Control (Industry); Fiber Composites; Aluminum Oxides; Manufacturing; Laser Heating; Single Crystals*

**19990008939** Toronto Univ., Dept. of Chemical Engineering and Applied Chemistry, Ontario Canada

**The Durability of Reinforced Polymers under Adverse Environments: Interface Effects Final Report, 15 Feb. 1995 - 15 Feb. 1998**

Piggott, M. R., Toronto Univ., Canada; Aug. 1998; 21p; In English

Contract(s)/Grant(s): F49620-95-1-0148

Report No.(s): AD-A354827; AFRL-SR-BL-TR-98-0669; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Three types of experiments have been carried out to determine interface properties: single fibre pull out, transverse tests on unidirectional composites and peel tests on single fibres. The pull out tests were shown to give misleading results: interfaces which pull out suggested were as strong or stronger than the matrix, yielded transverse strengths which were low, and transverse fracture surfaces which had abundant bare fibres on them. Transverse tests showed that composites are weakened by water, but did not clearly reveal whether a weakened interface was a contributory factor. Peel tests did show that some interfaces are weakened by water. Interfaces studied included glass, carbon and Kevlar with epoxy and carbon-PEEK. This last was very resistant to water, being virtually unaffected after 8000 h at 90 C.

DTIC

*Durability; Interfaces; Reinforced Plastics*

**19990008953** NASA Lewis Research Center, Cleveland, OH USA

**Effect of Layer-Graded Bond Coats on Edge Stress Concentration and Oxidation Behavior of Thermal Barrier Coatings**

Zhu, Dongming, Ohio Aerospace Inst., USA; Ghosn, Louis J., Case Western Reserve Univ., USA; Miller, Robert A., NASA Lewis Research Center, USA; Nov. 1998; 26p; In English; 193rd; High Temperature Corrosion and Materials Chemistry, 3-8 May 1998, San Diego, CA, USA; Sponsored by Electrochemical Society, Inc., USA

Contract(s)/Grant(s): RTOP 523-23-2U

Report No.(s): NASA/TM-1998-208505; NAS 1.15:208505; E-11331; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Thermal barrier coating (TBC) durability is closely related to design, processing and microstructure of the coating Z, tn systems. Two important issues that must be considered during the design of a thermal barrier coating are thermal expansion and modulus mismatch between the substrate and the ceramic layer, and substrate oxidation. In many cases, both of these issues may be best addressed through the selection of an appropriate bond coat system. In this study, a low thermal expansion and layer-graded



bond coat system, that consists of plasma-sprayed FeCoNiCrAl and FeCrAlY coatings, and a high velocity oxyfuel (HVOF) sprayed FeCrAlY coating, is developed to minimize the thermal stresses and provide oxidation resistance. The thermal expansion and oxidation behavior of the coating system are also characterized, and the strain isolation effect of the bond coat system is analyzed using the finite element method (FEM). Experiments and finite element results show that the layer-graded bond coat system possesses lower interfacial stresses, better strain isolation and excellent oxidation resistance, thus significantly improving the coating performance and durability.

Author

*Thermal Control Coatings; Thermal Expansion; Thermal Stresses; Sprayed Coatings; Oxidation; Flame Spraying; Durability; Coating; Ceramics*

**19990008983** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Transmission Electron Microscopic Observation of Electrodeposited Pt-Mo Alloy Films**

Shirouzu, Shin, Kyushu Sangyo Univ., Japan; Kobayashi, Shigeo, Kyushu Sangyo Univ., Japan; Tsuru, Toshiaki, Kyushu Sangyo Univ., Japan; Yanagase, Tsutomu, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 3, pp. 159-161; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The structure of Pt-Mo alloy films electrodeposited from alkaline ammoniacal solution was investigated by scanning electron microscopy (SEM) and transmission electron microscopy (TEM). As one of the various preparation methods for TEM observation of electrodeposited alloy films, ultramicrotomy has been used to prepare thin cross-sections of the Pt-Mo alloy films electrodeposited onto copper substrates. It was found that ultramicrotomed sections as thin as 20 nm or even less can be prepared successfully with negligible damage to the alloy films. The structure of electrodeposited Pt-Mo alloy films was briefly discussed.

Author

*Electrodeposition; Metal Films; Scanning Electron Microscopy; Transmission Electron Microscopy*

**19990008997** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**An Experiment on the Process for Producing Vapor Growth Carbon Fiber by CVD**

Fujimoto, Noboru, Kyushu Univ., Japan; Koyama, Shigeru, Kyushu Univ., Japan; Fujii, Tetsu, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 79-86; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experiment on the process for producing vapor growth carbon fiber by thermal decomposition of benzene in an atmosphere of hydrogen as carrier gas was carried out using a vertical quartz tubular reactor of 900 mm in length and 15.5 mm in inner diameter, the heating zone of which was 500 mm long. The effects of the reactor temperature and the flow rates of benzene and hydrogen on the yield of carbon fiber were examined, and the produced carbon fiber were observed with Scanning Electron Microscopy (SEM) to evaluate its quality and radial growth speed. One dimensional numerical analysis was also carried out using the model of carbon formation proposed by Matsumoto et al. The numerical result, however, showed the different trend from the experimental one.

Author

*Vapor Deposition; Carbon Fibers; Thermal Decomposition; Benzene*

**19990009034** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Temperature Gradient Thermally Stimulated Surface Potential in an LDPE Film Under a Non-Uniform Electric Field**

Fukuzawa, Masahiro, Kyushu Sangyo Univ., Japan; Hattori, Hirotaka, Kyushu Sangyo Univ., Japan; Iwamoto, Mitsumasa, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 97-103; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Thermally stimulated surface potential built up in a low density polyethylene (LDPE) film under a non-uniform electric field was investigated in the presence of a temperature gradient in the film. It was concluded that the thermally stimulated discharge at a temperature of -50 C was due to dipolar depolarization, whereas the discharge at a temperature of 50 C was due to thermal detrapping of carriers with positive polarity (holes).

Author

*Polyethylenes; Thin Films; Electric Potential; Depolarization; Holes (Electron Deficiencies); Electric Discharges; Temperature Gradients*

## PROPELLANTS AND FUELS

*Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.*

**19990008643** Federal Aviation Administration, Washington, DC USA

**A Review of the Flammability Hazard of Jet A Fuel Vapor in Civil Transport Aircraft Fuel Tanks *Final Report***

Fuel Flammability Task Group, Federal Aviation Administration, USA; Jun. 1998; 62p; In English

Report No.(s): AD-A355165; DOT/FAA/AR-98/26; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report documents the findings of a Fuel Flammability Task Group made up of recognized fuel and combustion specialists investigating the flammability and explosiveness of fuel within an aircraft fuel tank. The task group reviewed all available reports on the subject and met and discussed the data with technical experts from Boeing Commercial Airplane Co., California Institute of Technology, and the National Transportation Safety Board. The scope of the report includes jet fuel definitions and specifications, jet fuel flammability data, influences of various factors on fuel flammability, and predictive analyses and models for flammability. The report discusses the impact of this knowledge on the needs for in-flight fuel fire prevention.

DTIC

*Hazards; Fuel Tanks; Transport Aircraft; Jet Engine Fuels; Fire Prevention; Flammability; Vapors*

**19990008818** Advanced Sciences, Inc., Albuquerque, NM USA

**Disposal Technology for Solid Rocket Propellant *Final Report, 31 May 1995 - 19 Jun. 1998***

Attaway, Hubert, Advanced Sciences, Inc., USA; Jun. 19, 1998; 64p; In English

Contract(s)/Grant(s): F08635-90-C-0048; AF Proj. 2103

Report No.(s): AD-A354525; AFRL-ML-TY-TR-1998-4532; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The results of prior lab studies at Tyndall AFB were used to design, fabricate, and demonstrate a pilot-scale, complete AP (ammonium perchlorate) biodegradation (reactor) system using actual effluent from washout of Minutemen stage 2 propellant washout supplied by Aerojet's Propulsion Division. Using an anaerobic reactor (1600 gal) in conjunction with the HAP-1 micro-organism discovered AFRL, it was demonstrated in both tests at both Tyndall AFB and Thiokol-Morton (Utah) that virtually complete destruction of ammonium perchlorate in wastewaters was possible. The operating costs for the bioreactor system shows that fixed costs (electricity, maintenance, and labor) are at a minimum for 2000-4000 ppm perchlorate effluents. This is because maximum thruput can be achieved near 4000 ppm effluents. Nutrient cost is approximately linear with perchlorate reduced. As a result, up to 4000 ppm perchlorate effluents can be treated for less than \$0.10 per gallon.

DTIC

*Solid Rocket Propellants; Waste Disposal; Hazardous Wastes*

## ENGINEERING (GENERAL)

*Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.*

**19990008503** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

**Analysis of the Interaction Effect for Bonded Repairs**

Callinan, R. J., Defence Science and Technology Organisation, Australia; Rose, L. R. F., Defence Science and Technology Organisation, Australia; Sanderson, S., Defence Science and Technology Organisation, Australia; Aug. 1998; 18p; In English

Report No.(s): DSTO-TR-0715; DODA-AR-010-621; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001), Hardcopy, Microfiche

With the increasing use of bonded repairs to restore the structural integrity of ageing aircraft the question arises as to the interaction effects when repairs are located close together. Using the Finite Element (F.E.) method a study has been carried out for the interaction between two idealised circular repairs. The interaction involves the increase of the sheet stress just outside the patch. It has been found that the tandem orientation, with respect to the applied load, is the most severe configuration. In this case, for most practical repairs, the interaction may result in increases of the sheet stress by 40% for very close separation distances. It has also been found that certain combinations of bi-axial load can also significantly influence the interaction effect.

Author

*Axial Loads; Finite Element Method; Structural Failure*

**19990008661** General Electric Co., Engineering Mechanics Lab., Schenectady, NY USA

**Mechanical System Analysis/Design Tool (MSAT) Quick Guide *Final Report***

Lee, HauHua, General Electric Co., USA; Kolb, Mark, General Electric Co., USA; Madelone, Jack, General Electric Co., USA; Nov. 1998; 20p; In English

Contract(s)/Grant(s): NAS3-26617; RTOP 509-10-31

Report No.(s): NASA/CR-1998-208684; E-11438; NAS 1.26:208684; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

MSAT is a unique multi-component multi-disciplinary tool that organizes design analysis tasks around object-oriented representations of configuration components, analysis programs and modules, and data transfer links between them. This creative modular architecture enables rapid generation of input stream for trade-off studies of various engine configurations. The data transfer links automatically transport output from one application as relevant input to the next application once the sequence is set up by the user. The computations are managed via constraint propagation - the constraints supplied by the user as part of any optimization module. The software can be used in the preliminary design stage as well as during the detail design of product development process.

Author

*Design Analysis; Product Development*

**19990008743** Kagoshima Univ., Faculty of Engineering, Japan

**Fundamental Study on Magnetic Field Assisted Lapping with Rubber Magnet (Continuous Report)**

Tanaka, Hideho, Kagoshima Univ., Japan; Tomono, Haruhisa, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 35, pp. 1-5; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

It was mentioned in a previous report that lapping is also possible in the new type lapping method using a permanent rubber magnet proposed in the report as well as in conventional lapping. In this paper, various contrivance were made on the surface of the rubber magnet to be lap face. Furthermore, increasing experimental parameters by varying the lapping speed, the sorts and mixture ratio of lapping fluid, fundamental experimental data were obtained similarly as in the previous report.

Author

*Magnetic Fields; Rubber*

**19990008910** IBOS Qualitaetssicherungssysteme G.m.b.H., Aachen, Germany

**Intelligent Process Control with Evolution Strategy**

Offergeld, Heinz, IBOS Qualitaetssicherungssysteme G.m.b.H., Germany; Nov. 1998; 10p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

The tasks of process systems are multi-faceted and all aimed at minimisation of expenditure and related costs. Irrespective of the level at which they are used, the aim of such systems should be the continuous improvement of production. A closed optimisation cycle is created whereby all information related to the production is analysed and feedback to the production process is given. The basis of the introduced optimisation process is the evolutionary optimisation. Evolution is a very efficient optimisation process, which has produced astonishing results in nature. The evolution strategy uses the same basic principles as the biological evolution, such as mutation and selection. The on-line optimisation is limited to the optimisation of the machine settings. This may only be a small area of the influencing factors, such as moulds, materials, human and environment, but it is the only area in which direct, on-line interventions can be made during a running production. This paper describes the practical results which are achieved in using evolution strategy for the on-line optimisation of injection moulding processes. The results show that the productivity will be increased by up to 20%.

Author

*Process Control (Industry); Artificial Intelligence; Manufacturing; On-Line Systems; Production Engineering*

**19990008992** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Recent Advances in Enhancing Shell-Side Condensation in Refrigerant Condensers**

Honda, Hiroshi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 149-162; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper reviews recent advances that have been made in enhancing film condensation of fluorocarbon refrigerants in a bundle of horizontal tubes. The emphasis in the discussion is on the effects of fin geometry, vapor shear and condensate inundation. It is shown that the fin geometry is an important factor that controls the heat transfer performance. The effect of vapor shear is much smaller for a finned tube than for a smooth tube. The effect of condensate inundation is more marked for a three dimensional



fin tube than for a two dimensional fin tube. Also, the effect is more marked for an in line tube bundle than for a staggered tube bundle. For a two-dimensional fin tube with and without the effect of vapor shear and for a bundle of two dimensional fin tubes with negligible vapor shear, several theoretical models exist that can predict the heat transfer coefficient with sufficient accuracy. The theoretical model can be used to optimize the fin geometry.

Author

*Shells (Structural Forms); Film Condensation; Refrigerants; Condensers (Liquefiers)*

**19990009076** NASA Marshall Space Flight Center, Huntsville, AL USA

**Design Optimization and Analysis of a Composite Honeycomb Intertank**

Finckenor, Jeffrey, NASA Marshall Space Flight Center, USA; Spurrier, Mike, NASA Marshall Space Flight Center, USA; 1998; 10p; In English; 6th; OPTI99: Computer Aided Optimum Design of Structures, 16-18 Mar. 1999, Orlando, FL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Intertanks, the structure between tanks of launch vehicles, are prime candidates for weight reduction of rockets. This paper discusses the optimization and detailed analysis of a 96 in (2.44 m) diameter, 77 in (1.85 m) tall intertank. The structure has composite face sheets and an aluminum honeycomb core. The ends taper to a thick built up laminate for a double lap bolted shear joint. It is made in 8 full length panels joined with bonded double lap joints. The nominal load is 4000 lb/in ( $7 \times 10^5$  N/m). Optimization is by Genetic Algorithm and minimizes weight by varying C, core thickness, number and orientation of acreage and buildup plies, and the size, number and spacing of bolts. A variety of cases were run with populations up to 2000 and chromosomes as long as 150 bits. Constraints were buckling, face stresses (normal, shear, wrinkling and dimpling, bolt stress, and bolt hole stresses (bearing, net tension, wedge splitting, shear out and tension/shear out). Analysis is by a combination of theoretical solutions and empirical data. After optimization, a series of coupon tests were performed in conjunction with a rigorous analysis involving a variety of finite element models. The analysis and test resulted in several small changes to the optimized design. The intertank has undergone a 250,000 lb ( $1.1 \times 10^6$  N) limit load test and been mated with a composite liquid hydrogen tank. The tank/intertank unit is being installed in a test stand where it will see 200 thermal/load cycles. Afterwards the intertank will be demated and loaded in compression to failure.

Author

*Design Analysis; Optimization; Honeycomb Structures; Weight Reduction; Load Tests; Honeycomb Cores; Finite Element Method; Genetic Algorithms*

## 32

### COMMUNICATIONS AND RADAR

*Includes radar; land and global communications; communications theory; and optical communications. For related information see also 04 Aircraft Communications and Navigation and 17 Space Communications, Spacecraft Communications, Command and Tracking. For search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation.*

**19990008645** Electro-Radiation, Inc., Totowa, NJ USA

**EW Testing Lessons Learned**

Berkowitz, Paul H., Electro-Radiation, Inc., USA; Jun. 16, 1998; 14p; In English  
Report No.(s): AD-A355203; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Electronic Warfare (EW) testing is one of the more challenging undertakings in the Avionics community. EW tests are typically fraught with a myriad of problems due to the inherent complexity of tests involving multiple vehicles, radars, data collection, and data processing, as well as the complex nature of Electronic Warfare itself. Electro-Radiation Inc. (ERI) has been at the forefront of EW testing for many years, from B-52 to B-2 and from F-101 to F-22. While it is impossible to prevent all problems, it is possible to prevent the same problems from repeating. This paper applies many of the lessons ERI learned from its extensive EW testing experience, and offers recommendations of how to avoid repeating them. Electro-Radiation Inc. (ERI) has been a leader in the field of Electronic Warfare (EW) testing for many years. During this time, it has been seen that the complexities of EW testing create an enormously challenging environment. A typical EW flight test involves multiple aircraft, both jammers and victims; ground test radars; ground reference radars; airborne reference radars; a central facility for real time flight and test control; telemetry and displays for real time observation; data collection; post data processing to generate error information; a laboratory to test and program the EW system, with associated signal sources, meters, scopes, monitors, test boxes, reprogramming tools, and spares for emergency repair/rework; and a classified work area with data storage for manuals and test data. For any single day's test, as many as 50 people from several Government agencies and contractors can be involved. In the center of this is the

EW tester, who has responsibility for about 100 variables and control of perhaps 3. Given this complex scenario, it is not surprising that many problems arise. It is virtually impossible to run such an enterprise without problems.

DTIC

*Avionics; Electronic Warfare; Aircraft Equipment; Flight Tests*

**19990008670** Department of the Navy, Washington, DC USA

**Moving Map Composer (MMC)**

Gendron, Marlin L., Inventor, Department of the Navy, USA; Wischow, Perry B., Inventor, Department of the Navy, USA; Trenchard, Michael E., Inventor, Department of the Navy, USA; Lohrenz, Maura C., Inventor, Department of the Navy, USA; Jul. 30, 1998; 42p; In English

Patent Info.: Filed 30 Jul. 1998; US-Patent-Appl-SN-09126386

Report No.(s): AD-D019046; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This invention pertains generally to a method and apparatus for displaying a selected geographic area on a video display and more specifically to the providing of a user-friendly graphical interface that defines a template and builds an aircraft optical disk image (AODI) from the data available within the given template's boundaries.

DTIC

*Optical Disks; Templates; Maps; Television Cameras; Video Landmark Acquisition and Tracking; Mapping; Display Devices*

**19990008727** Army Communications-Electronics Command, Fort Monmouth, NJ USA

**Text Independent Speaker Recognition Using A Fuzzy Hypercube Classifier**

Karakowski, Joseph A.; Phu, Hai H.; Oct. 1998; 43p; In English

Report No.(s): AD-A354792; CECOM-TR-98-5; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The recognition of speakers in an open set, text-independent environment is described. The recognition occurs without any prior training, and occurred in both noisy and clear backgrounds in as little as 1.6 seconds. Investigations and testing were done in the areas of feature characterization of speakers, prefiltering of classifier input, and structure of classifiers for recognition. A prefiltering structure for speech input segments using an expert system implementing hypothesize and test for relevance was investigated. This attempts to maximize classification performance by preselection of most likely voiced speech segments prior to classification. The classifier used was based on Adaptive Resonant Theory and fuzzy Min-Max. It is a neural network with output categories represented by a fuzzy hypercube. The network is described in a hybrid neuronal-functional method. A speaker recognition system was tested using the Switch-board and Greenflag databases. Utterances averaging 0.5 to 7.0 seconds in length were tested, with over 5 hours of conversation for 8, 12 and 16 speaker groups.

DTIC

*Classifications; Classifiers; Conversation; Expert Systems*

**19990008763** Marquette Univ., Milwaukee, WI USA

**AAH Cage Out-Link and In-Link Antenna Characterization Final Report, 15 Nov. 1996 - 31 Jul. 1998**

Jeutter, Dean C., Marquette Univ., USA; 1998; 17p; In English; Original contains color illustrations

Contract(s)/Grant(s): NCC2-5228; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This final report encapsulates the accomplishments of the third year of work on an Advanced Biotelemetry System (ABTS). Overall MU/ABTS project objectives are to provide a biotelemetry system that can collect data from and send commands to an implanted biotransceiver. This system will provide for studies of rodent development in space. The system must be capable of operating in a metal animal cage environment. An important goal is the development of a small, "smart", micropower, implantable biotransceiver with eight-channel data output and single channel command input capabilities with the flexibility for easy customization for a variety of physiologic investigations. The NASA Ames/Marquette University Joint Research work has been devoted to the system design of such a new state of the art biotelemetry system, having multiple physiologic inputs, and bi-directional data transfer capabilities. This work has provided a successful prototype system that connects, by two-way radio links, an addressable biotelemetry system that provides communication between an animal biotelemetry prototype and a personal computer. The operational features of the prototype system are: (1) two-way PCM communication with implanted biotelemetry; (2) microcontroller based biotelemetry; (3) out-link: wideband FSK (60 kbaud); (4) in-link: OOK (2.4 kbaud); (5) septum antenna arrays (In/Out-Links); and (6) personal computer data interface. The important requirement of this third year's work, to demonstrate two-way communication with transmit and receive antennas inside the metal animal cage, has been successfully accomplished. The advances discussed in this report demonstrate that the AAH cage antenna system can provide Out-link and In-link capability for the ABTS bi-directional telemetry system, and can serve as a benchmark for project status. Additions and enhancements to the most recent (April 1997) prototype cage and antenna have been implemented. The implementation, testing, and documentation

was accomplished at the Biotelemetry Laboratory at Marquette University with Out-Link (slot) antenna design assistance was provided.

Author

*Biotelemetry; Data Acquisition; Data Base Management Systems; Telemetry; Channels (Data Transmission); Antenna Design*

**19990008817** Rensselaer Polytechnic Inst., Troy, NY USA

**Adaptive Spread Spectrum Systems Using Filterbanks and the Discrete Wavelet Transform** *Final Report, Sep. 1995 - Jan. 1998*

Saulnier, G. J., Rensselaer Polytechnic Inst., USA; Hetling, K. J., Rensselaer Polytechnic Inst., USA; Das, P. K., Rensselaer Polytechnic Inst., USA; Aug. 1998; 145p; In English

Contract(s)/Grant(s): F30602-95-C-0167; AF Proj. 4519

Report No.(s): AD-A354505; AFRL-IF-RS-TR-1998-170; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report discusses the development of new approaches for providing anti-jam, multipath resistant, multi-user communications based on filterbank and wavelet techniques. The first portion considers the synthesis of spreading waveforms using full binary tree multi-rate filterbank design techniques. Non-binary spreading waveforms are produced that are optimized for multi-user, multipath and interference channels and shown to out-perform some conventional spreading sequences. The second part of the report describes and evaluates a spread spectrum version of Orthogonal Frequency Division Multiplexing (OFDM) wherein the same information is transmitted on multiple orthogonal carriers, creating both time and frequency diversity. In the receiver, time domain and transform domain excision are used to improve performance in pulsed wideband or narrowband jamming, respectively. In addition, the report considers replacing the inverse and forward FFT's commonly used in OFDM systems with inverse and forward Modulated Lapped Transforms (MLT's). Performance results demonstrate the effectiveness of the techniques. For both the spreading waveform design and OFDM work, simulations were performed using the Signal Processing WorkSystem (SPW) from AltaGroup of Cadence Design Systems, Inc.

DTIC

*Adaptation; Spreading; Spread Spectrum Transmission; Wavelet Analysis; Transformations (Mathematics); Telecommunication*

**19990008892** Rensselaer Polytechnic Inst., Troy, NY USA

**Enhanced Time Domain Interference Suppression Techniques** *Final Report, Jun. - Sep. 1997*

Saulnier, Gary J., Rensselaer Polytechnic Inst., USA; Aug. 1998; 51p; In English

Contract(s)/Grant(s): F30602-97-1-0206; AF Proj. 2304

Report No.(s): AD-A354501; AFRL-IF-RS-TR-1998-169; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Many methods have been proposed for suppressing interference in a direct sequence spread spectrum signal and a number of these utilize adaptive transversal suppression filters to remove a large portion of the interference prior to despreading. This report investigates the performance of predictive and two-sided adaptive filtering systems and presents a method to improve the performance of the predictive filter by compensating for the distortion introduced into the desired direct sequence signal during the adaptive filtering process. It is shown that the predictive filter acts as a pre-whitener and the two-sided filter acts as a power inverter. Additionally, the two-sided adaptive filter automatically performs the same function as the compensated predictive filter. The performance of the adaptive systems is also studied when there is multipath propagation and it is shown that the presence of multipath allows the filters to partially suppress the desired direct sequence signal, resulting in performance loss. A combination of simulation and analysis was used to perform this study. Simulations were performed using the Signal Processing Work System (SPW) from Alta Group of Cadence Design Systems, Inc.

DTIC

*Adaptation; Adaptive Filters; Spread Spectrum Transmission; Time*

**19990008973** Teledyne Brown Engineering, Huntsville, AL USA

**Radar Credible Target-1 (RCT-1) Flight Test: An Innovative Solution for Ground Based Radar-Prototype (BGR-P) Testing**

Eversmeyer, Kent E.; Henley, Jess; Harper, Robert; Talbert, Dan; Caruso, Gerald; Jan. 1998; 5p; In English

Report No.(s): AD-A355732; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This paper provides an overview of the innovative solutions developed to meet the requirements of the target set designed for the Ground Based Radar Prototype (GBR-P) Radar Credible Target (RCT-1) flight test. The methodology used to design and plan this Target of Opportunity (TOO) mission as a Minuteman 3 Associated Operation mission is presented. Solutions developed for the fundamental target designs and their truth data instrumentation are presented in context with the deployment schema developed for RCT-1. In addition, an innovative and cost effective chaff target concept to be tested on RCT-1 is presented with respect

to possible out year Integrated Flight Test requirements. Emphasis is placed on the lessons learned to date from this process, and applicability to further NMD flight testing.

DTIC

*Flight Tests; Prototypes; Radar Targets; Targets*

**19990009045** National Defence Research Establishment, Avdelningen foer Sensorteknik, Linkoeeping, Sweden

**Survey of receivers and signal analysis for an FMCW semiconductor laser radar** *Topical Report Oeversikt av Mottagare och Signalanalys foer en FMCW Halvledarlaserradar*

Karlsson, C., National Defence Research Establishment, Sweden; Agren, P., National Defence Research Establishment, Sweden; Letalick, D., National Defence Research Establishment, Sweden; Feb. 1998; 34p; In Swedish; In English  
Report No.(s): PB99-103483; FOA-R-98-00723-408-SE; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

In the report, a specification of important parameters of a receiver for an FMCW semiconductor laser radar is given. The specification is based on the characteristics of the signal from the laser radar and on the desired range resolution of the system etc. In addition, a survey of conceivable receivers is given. The characteristics of the signal is given partly by the coherence length of the laser, which is an important parameter for the frequency accuracy that in turn determines the range accuracy. The investigations in this report is a part of activities which investigates the possibilities to accomplish small, robust and whispering semiconductor laser radar system for several military applications.

NTIS

*Surveys; Receivers; Signal Analysis; Semiconductor Lasers; Optical Radar; Frequency Modulation; Continuous Wave Lasers*

**19990009048** Florida Univ., College of Journalism and Communications, Gainesville, FL USA

**Communications Contingency Plan: Planning for Crises and Controversy, Phase 1**

Treise, Deborah, Florida Univ., USA; Bernstein, Arla G., Florida Univ., USA; Yates, Brad, Florida Univ., USA; Apr. 15, 1998; 57p; In English

Contract(s)/Grant(s): NASA Order H-28167-D; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Interviews were conducted with a variety of Marshall Space Flight Center personnel and local media representatives in Huntsville, Alabama, in order to identify the current perceptions of these individuals regarding communication effectiveness between MSFC and the media. The purposes of the Phase One report are to (1) assess the need for a contingency plan for communicating in situations of crisis and controversy; (2) identify goals and objectives for the planning process; and (3) provide recommendations for future planning activities to achieve the goals and objectives outlined in Phase One. It is strongly recommended that MSFC personnel who are involved in communications with the media participate in a facilitated, strategic communications planning process in order to develop Phase Two of the Communications Contingency Plan (CCP). Phase Two will address (1) the categorizing, ranking and prioritizing of crises and controversies; (2) the development of action steps and implementation strategies for the CCP; and (3) the development of a monitoring and evaluation process for ongoing plan effectiveness.

Author

*Communicating; Contingency; Management Planning; NASA Programs*

**19990009084** National Defence Research Establishment, Avdelningen foer Sensorteknik, Linkoeeping, Sweden

**Multifunction Radar with Digital Array Antennas** *Flerfunktionsradar med Digitala Gruppantennor*

Grahn, P., National Defence Research Establishment, Sweden; Alm, A., National Defence Research Establishment, Sweden; Bjoerklund, S., National Defence Research Establishment, Sweden; Mylen, L., National Defence Research Establishment, Sweden; Nelander, A., National Defence Research Establishment, Sweden; Mar. 1998; 46p; In Swedish  
Report No.(s): PB99-103434; FOA-R-98-00748-408-SE; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

This report is a user oriented summary of multifunction radar with digital array antennas for future army, marine and air force applications. Future radar systems will to an increasing extent be adaptive, i.e. they will adapt their functions to the prevailing measurement situation. These systems utilize an electronically controlled array antenna which is formed by an array of modules, each one consisting of antenna element, transmitter, receiver, and A/D converter. The digital signals from each channel are combined by digital signal processing. Flexible signal generators are used to adapt the transmitted signal to each type of target, radar function, and situations. It is natural to divide the decision problem into two parts: the decision of what is to be done, and the opti-



mization of the parameters for the measurements to be made. The choice of the parameters and the time of measurement are scheduled in an optimum way. The decision of what is to be done can be aided by knowledge based techniques.

NTIS

*Antenna Arrays; Radar Antennas; Digital Systems*

**19990009087** National Defence Research Establishment, Dept. of Command and Control Warfare Technology, Linköping, Sweden

**Electronic Warfare Protection of Armored Vehicles, EW-Suite: Radio Communication in the Oxygen Band. Pilot Study VMS Stridsfordon Radiokommunikation vid 60 GHz: Foerstudie**

Asp, B., National Defence Research Establishment, Sweden; Jan. 1998; 32p; In Swedish

Report No.(s): PB99-103517; FOA-R-00701-616-SE; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

This report deals with the results from an introductory study. Central issues are the possibilities and problems which arise with communication at 60 GHz. As a introduction, the wave propagation effects and their implications are discussed. Furthermore, communication system requirements are penetrated, and finally suggestions for further activities are presented. The oxygen band offers high data transfer capacity, excellent LPI performance, robustness to jamming, and no need for frequency planning. The prize for this, however, is a very short distance range, even at line of sight conditions, typically 500 to 1000 m. In hilly woodland the distance is further reduced. Still, area coverage may be obtained with the use of a distributed network. This study has revealed many difficulties. Some of them have a fundamental impact of system performance. It is thus impossible with present knowledge to determine if a system which can handle the outlined communication scenarios is technically and economically feasible.

NTIS

*Electronic Warfare; Protection; Radio Communication; Oxygen; Bands; Communication Networks*

### 33

## ELECTRONICS AND ELECTRICAL ENGINEERING

*Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also 60 Computer Operations and Hardware and 76 Solid-State Physics.*

**19990008499** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Waveform Approximation Technique for CMOS Gates in the Switch-Level Timing Simulator BTS**

Chang, Molin, National Taiwan Univ.; Wang, Jyh-Herng, National Taiwan Univ.; Yih, Shuih-Jong, National Taiwan Univ.; Feng, Wu-Shiung, National Taiwan Univ.; Journal of the Chinese Institut of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 255-268; In English

Contract(s)/Grant(s): NSC85-2215-E-002-020; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A switch-level timing simulator has the advantage of fast speed and good adaptability for VLSI circuits, but it cannot offer accurate transient waveform information. In this paper an accurate and efficient switch-level timing simulator is described. The high accuracy is attributed to a new waveform approximation technique, which includes delay estimation and slope estimation. Efficient delay and slope calculations are accomplished through a switch-level simulation instead of using a transistor-level simulation. A new approach for delay estimation is presented which models the delay behavior of an RC tree by two equations: a dominant delay equation and an error delay equation. Both are derived by surface fitting to approximate the surface that is measured from the actual delay behavior of a CMOS gate. A modified approach for slope estimation is also investigated which has close relationship with the equivalent RC time constant of the evaluated cluster circuit. This equivalent RC time constant can be obtained by traversing the tree recursively. The results show good agreement with SPICE.

Author

*Approximation; Waveforms; Simulation; Time Constant; Simulators; Switches; Circuits*

**19990008578** NASA Langley Research Center, Hampton, VA USA

**High Displacement Solid State Ferroelectric Loudspeaker**

Regan, Curtis R., Inventor, NASA Langley Research Center, USA; Jalink, Antony, Jr., Inventor, NASA Langley Research Center, USA; Hellbaum, Richard F., Inventor, NASA Langley Research Center, USA; Rohrbach, Wayne W., Inventor, NASA Langley Research Center, USA; Sep. 01, 1998; 8p; In English; Continuation-in-part of abandoned US-Patent-Appl-SN-326804, filed 11 Oct. 1994

Patent Info.: Filed 13 Jan. 1997; NASA-Case-LAR-15138-2; US-Patent-5,802,195; US-Patent-Appl-SN-782851; US-Patent-Appl-SN-326804; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A piezoelectric loudspeaker suitable for midrange frequencies uses a dome shaped piezoelectric actuator to a speaker membrane directly is discussed. The dome shaped actuator is made from a reduced and internally biased oxygen wafer, and generates excursion of the apex of the dome in the order of 0.02-0.05 inches when a rated drive voltage of 350 V rms is applied between the convex and the concave surface of the dome shaped actuator. The load capacity exceeds 10 lbs. The edge of the rim of the dome shaped actuator must be free to rock when the dome height varies to ensure low distortion in the loudspeaker. This is achieved by mounting the rim of the dome shaped actuator on a support surface by prestress only. An exceptionally simple design uses a planar speaker membrane with the center part of one side pressed against the rim of a dome shaped actuator by prestress from a stretched latex surround member.

Official Gazette of the U.S. Patent and Trademark Office

*Ferroelectricity; Solid State; Actuators; Electric Potential; Loudspeakers; Membranes; Piezoelectricity*

**19990008706** Villanova Univ., Dept. of Electrical and Computer Engineering, PA USA

**Investigation of a New Class of Low-Profile Multi-Layer Printed Antennas** *Annual Report, 15 Oct. 1997 - 30 Sep. 1998*

Hoorfar, Ahmad, Villanova Univ., USA; Dec. 01, 1998; 26p; In English

Contract(s)/Grant(s): N00014-98-1-0090

Report No.(s): AD-A355027; TR-527615; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This progress report outlines our research efforts on modeling, analyses and optimization of a novel class of multi-layered printed antennas for high gain applications. The proposed antennas, which are based on a multi-layer printed circuit version of the conventional Yagi array, are very attractive for applications that require high gain antennas in a compact low profile package. Presence of the dielectric layers not only hinders the need for structural support of the antenna but also provides a few more degrees of freedom for gain optimization. In addition, these antennas can be made conformal to various shapes and surfaces. Our research during this interim period has resulted in three contributions: (1) We have developed a numerical code for efficient electromagnetic modeling of these Yagi like structures. A novel feature of this code is a new semi-analytical technique that speeds up the evaluation of the corresponding Green's functions by a factor of 10 or higher. (2) The feasibility of obtaining high gain from the proposed Yagi like arrays is investigated by performing a detailed parametric study for structures with up to 5 dielectric layers. (3) We have developed an electromagnetic optimization engine based on Evolutionary Programming. This code is applied to optimal design of the printed Yagi like arrays. Optimization is performed with respect to lengths of driver and director elements as well as dielectric constants and thickness of layers under different constraints' criteria. It is shown that a globally optimized three layer structures can achieve a gain of 13 dBi or higher without the need for high permittivity dielectric layers.

DTIC

*Printed Circuits; High Gain; Yagi Antennas*

**19990008731** Naval Surface Warfare Center, Carderock Div., Bethesda, MD USA

**Development of a SEAL Delivery Vehicle Battery**

Gessler, Joseph L.; Romero, Antonio; Staniewicz, Robert J.; Nov. 1997; 160p; In English

Report No.(s): AD-A354961; NSWCCD-TR-97/010; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The goal of this program was to demonstrate performance in cells sized for use in the SEAL Delivery Vehicle. Development efforts by Saft, America, Inc. are reported for batteries to power undersea vehicles. Large, prismatic cells were designed, built, and tested in sizes up to 150 Ah, and demonstrated energy densities up to 130 Wh/Kg. The anodes were either metallic lithium or a lithium-intercalating carbon. Cathodes were lithiated metal oxides of cobalt or nickel (Li(x)CoO<sub>2</sub> or Li(x)NiO<sub>2</sub>). The electrolyte was 1.2 M LiAsF<sub>6</sub> in mixed solvents ethylene carbonate, propylene carbonate, and dimethyl carbonate in a 1:1:2 ratio. Several different cell designs were explored, some of which included novel features such as case strengthening by pinning together opposing faces and orienting the plates parallel to the narrow case faces. These and other design features were needed to address the effect of stack bulging during cycling. Electronics to control charge and discharge and to ensure safe operation were proposed. Safety of the electrochemistries was evaluated by testing 4/5 A-size cells.

DTIC

*Anodes; Bulging; Carbon; Carbonates; Cathodes; Cobalt*



**19990008747** Department of the Navy, Washington, DC USA

**Process for Making a Semiconductor Device with Barrier Film Formation Using a Metal Halide and Products Thereof**  
Stumborg, Michael F., Inventor; Santiago, Francisco, Inventor; Chu, Tak Kin, Inventor; Boulais, Kevin A., Inventor; Aug. 20, 1998; 51p; In English

Patent Info.: Filed 20 Aug. 1998; US-Patent-Appl-SN-09137089

Report No.(s): AD-D019029; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche  
No Abstract

Author

*Metal Halides; Semiconductor Devices; Parametric Amplifiers; Molecular Electronics*

**19990008820** Microelectronics Center of North Carolina, Microelectromechanical Systems Technology Applications Center, Research Triangle Park, NC USA

**MEMS Sensors Commercial Technology Insertion Program (CTIP) Final Report, 1 May 1997 - 30 Jul. 1998**

Wood, Robert L., Microelectronics Center of North Carolina, USA; Oct. 06, 1998; 46p; In English

Contract(s)/Grant(s): N00014-97-1-0660

Report No.(s): AD-A354557; C97-5113-820; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes results of efforts under the MEMS Sensor Commercial Technology Program (CTIP) from 5, 1997 through 6, 1998. The program was established to assist Naval Surface Warfare Center (NSWC) Indian Head Division in procurement, characterization, and fabrication of COTS sensors applicable to the SMTD S & A system as well as general DoD needs. Highlights of major accomplishments are provided.

DTIC

*Microelectromechanical Systems; Microelectronics; Multisensor Applications*

**19990008852** Utah State Univ., Electrical Engineering Dept., Logan, UT USA

**Recommended Practice; Symbols, Terms, Units and Uncertainty Analysis for Radiometric Sensor Calibration**

Wyatt, Clair L., Utah State Univ., USA; Privalsky, Victor, Utah State Univ., USA; Datla, R., National Inst. of Standards and Technology, USA; Sep. 1998; 132p; In English

Report No.(s): PB99-105827; NIST/HB-152; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This handbook provides recommendations for nomenclature, terms, symbols, units and uncertainty analysis associated with the calibration of radiometric sensor systems. The scope includes the radiant properties of sources; the geometry of radiation transfer; the measurement equation used to predict sensor response; the calibration equation used to convert sensor response to engineering units (radiance, irradiance, etc.); and the uncertainty analysis. The contents are organized to correspond, somewhat, to the normal flow of flux (source to sensor) and of analysis (predicted performance to generation of calibration equations and uncertainty analysis).

NTIS

*Symbols; Terms; Radiometers; Calibrating; Nomenclatures; Units of Measurement; Procedures*

**19990008882** Michigan Univ., Dept. of Electrical Engineering and Computer Science, Ann Arbor, MI USA

**Silicon-Based On-Wafer Packaging for High Isolation in High-Density Circuits Annual Report**

Katehi, Linda P.; Oct. 30, 1998; 11p; In English

Contract(s)/Grant(s): N00014-95-1-0546

Report No.(s): AD-A355698; UM/EECS-033095-2-T; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This project concentrates on the development and demonstration of a novel approach which is appropriate for the development of circuits that require high isolation and high density of integration. In the past ten months, we have extensively investigated the development of a vertically integrated circuit configuration with emphasis on understanding cross talk in various architectures in an effort to minimize it while at the same time circuit efficiency is optimized. The developed architectures for maximum isolation and minimum loss are presently applied towards the design of a three-stage low-noise amplifier. With the successful completion of this LNA (expected by the end of November) we will successfully move towards the development of a K/Ka-Band SSPA/LNA amplifier pair with an isolation between the receiving and transmitting components of better than -80 dB. In both configurations, high isolation between the neighboring circuit components will be achieved by vertically integrating the individual components and by incorporating an effective on-wafer Si micromachined package to further isolate electromagnetically the

MMIC components. The performance will be compared to the state-of-the-art to demonstrate excellent electrical response with low cost and high density.

DTIC

*Integrated Circuits; Silicon; Wafers; Isolation; Microwave Amplifiers; Microwave Circuits; Solid State Devices*

**19990008883** Naval Postgraduate School, Monterey, CA USA

**Using the Pebb Universal Controller to Modify Control Algorithms for DC-to-DC Converters and Implement Closed-Loop Control of ARCP Inverters**

Flooden, David L.; Sep. 1998; 124p; In English

Report No.(s): AD-A355736; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The objective of this thesis is two-fold. The first goal is to expand the operational capabilities of the Ship's Service Converter Module control algorithm for a DC-to-DC converter using the Universal Controller. The second goal is to investigate the use of the Universal Controller to implement a closed-loop control algorithm for an Auxiliary Resonant Commutated Pole (ARCP) power inverter. These power electronic devices are central to the development of a DC Zonal Electric Distribution System (DC ZEDS) that is scheduled for application in the twenty-first century surface combatant (SC-21). The development of appropriate control algorithms is a key element to this design process. The Universal Controller is a digital controller that was developed by personnel at the Naval Surface Warfare Center (NSWC), Annapolis, Maryland. The basic operation of the Universal Controller and the Texas Instrument TMS320C30 microprocessor architecture are described, with emphasis placed on the system control algorithms. Previous studies have encoded and successfully tested a closed-loop control algorithm for a DC-to-DC converter. In this research endeavor, this control algorithm is expanded to include various protection circuits and a Master/Slave paralleling scheme. Finally, a closed-loop control algorithm for the ARCP inverter is encoded and recommendations for future research are outlined.

DTIC

*Algorithms; Digital Systems; Voltage Converters (DC to DC); Controllers; Feedback Control*

**19990008932** Department of the Navy, Washington, DC USA

**Electronic Devices with Rubidium Barrier Film and Process for Making Same**

Stumborg, Michael F., Inventor, Department of the Navy, USA; Santiago, Francisco, Inventor, Department of the Navy, USA; Chu, Tak-Kin, Inventor, Department of the Navy, USA; Boulais, Kevin A., Inventor, Department of the Navy, USA; Aug. 20, 1998; 51p; In English

Patent Info.: Filed 20 Aug. 1998; US-Patent-Appl-SN-9137087

Report No.(s): AD-D019038; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

A semiconductor device having a barrier film comprising an extremely thin film formed of one or more monolayers each comprised of a two-dimensional array of metal atoms. In one exemplary aspect, the barrier film is used for preventing the diffusion of atoms of another material, such as a copper conductor, into a substrate, such as a semiconducting material or an insulating material. In one mode of making the semiconductor device, the barrier film is formed by depositing a precursor, such as a metal halide (e.g., BaF<sub>2</sub>), onto the substrate material, and then annealing the resulting film on the substrate material to remove all of the constituents of the temporary heteroepitaxial film except for a monolayer of metal atoms left behind as attached to the surface of the substrate. A conductor, such as copper, deposited onto the barrier film is effectively prevented from diffusing into the substrate material even when the barrier film is only one or several monolayers in thickness. The extremely thin barrier film makes possible a significant increase in the component density and a corresponding reduction in the number of layers in large scale integrated circuits, as well as improved performance.

DTIC

*Rubidium; Barium Fluorides; Thin Films; Semiconductor Devices*

**19990008985** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Proximity Effect and Anisotropy in NbTi Multifilamentary Wires**

Aoki, Yoshiyuki, Kyushu Sangyo Univ., Japan; Akune, Tadahiro, Kyushu Sangyo Univ., Japan; Sakamoto, Nobuyoshi, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 113-120; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Current densities  $J(\text{sub cp})$  of proximity-induced superconducting matrices in NbTi multifilamentary wires are anisotropic depending on the current directions. In measurements with sample wire to observe the superconducting characteristics, much attention should be paid to the effect of wire length to estimate the length dependence caused by this anisotropy. From twist-pitch dependence of the wire magnetization, the proximity current is estimated. The wire length dependence of the proximity-induced

magnetization is satisfactorily analyzed by applying 2-dimensional Irie-Yamafuji theory on the proximity currents. In the short wires, the fluxoid motion along the wire axis is suggested to take place and to modify the apparent wire characteristics.

Author

*Proximity Effect (Electricity); Anisotropy; Wire; Length; Filaments*

**19990009039** Kyushu Univ., Faculty of Engineering, Fukuoka, Japan

**Infinite Impulse Response (IIR) Digital Filter Characteristics Approximated by Using Minimum Number of Interpolation Points**

Suhara Yoshiro, Kyushu Univ., Japan; Koga, Tosihiro, Kyushu Univ., Japan; Technology Reports of Kyushu University; Mar. 1994; ISSN 0023-2718; Volume 67, No. 2, pp. 127-153; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The authors recently proposed a design method of stable Infinite Impulse Response (IIR) digital filters based on Lagrange interpolation by rational functions for a set of values and higher derivatives of characteristic functions of filters prescribed at a number of angular frequencies. This paper discusses two advanced problems concerning the interpolated IIR digital filters. One is a method of designing the filters with characteristic rational functions having finite zeros and poles of arbitrary degree. The other is the presentation of the frequency characteristics of filters with the minimum number of interpolation points by comparing numerically with the other filters. One of the fundamental frequency characteristics of the filters are also shown.

Author

*Impulses; Procedures; Digital Filters; Frequency Distribution; Angular Distribution; Approximation*

**19990009044** National Defence Research Establishment, Avdelningen foer Sensorteknik, Linkoeeping, Sweden

**Antenna Integrated Microwave Technology Antennintegrerad Mikrovagsteknik Slutrapport**

Nelander, A., National Defence Research Establishment, Sweden; Ottersten, H., National Defence Research Establishment, Sweden; Pettersson, L., National Defence Research Establishment, Sweden; Danestig, M., National Defence Research Establishment, Sweden; Grahn, P., National Defence Research Establishment, Sweden; May 1998; 64p; In Swedish Report No.(s): PB99-108664; FOA-R-98-00789-408-SE; No Copyright; Avail: Issuing Activity (Nat'l Technical Information Service (NTIS)), Microfiche

This report summarizes five years of studies in Antenna Integrated Microwave Technology (AIMT) at FOA and is prepared primarily for defense decision makers and technical officials with interest in future techniques for phased array antennas for radar and electronic countermeasures. The AIMT studies have resulted in considerable improved knowledge of the construction, architecture, system design, performance evaluation, and use of digital array antennas. A functional experimental digital array antenna demonstrator has been built. The measurements and experiments which have been performed have resulted in know-how which not allows the design of future multibeam antennas for applications such as air defense surveillance and anti-aircraft radars. AIMT techniques provide new options for improved performance, more functions, and platform integration both for radar and countermeasure systems. The techniques may also be introduced when operational systems are upgraded. For future radar systems the digital techniques will have profound implications.

NTIS

*Antenna Arrays; Microwave Equipment; Systems Engineering; Structural Design; Phased Arrays; Digital Systems; Digital Techniques; Radar Antennas*

**19990009060** Space and Naval Warfare Systems Center, San Diego, CA USA

**Improved Second-Generation 3-D Volumetric Display System Final Report**

Soltan, P., Space and Naval Warfare Systems Center, USA; Lasher, M., Space and Naval Warfare Systems Center, USA; Dahlke, W., Space and Naval Warfare Systems Center, USA; McDonald, M., Space and Naval Warfare Systems Center, USA; Acantilado, N., Space and Naval Warfare Systems Center, USA; Aug. 1998; 264p; In English

Report No.(s): AD-A355592; TR-1763-Rev-1; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The Space and Naval Warfare (SPAWAR) Systems Center, San Diego (SSC San Diego) Simulation and Human Technology Division has developed and improved its second-generation 3-D Volumetric Display System for displaying data, information, and scenes in a three-dimensional volume of image space. The system has good potential for many military and commercial applications. Based on a computer-controlled laser optics system that projects three laser beams simultaneously onto a 36-inch diameter/18-inch-high double helix spinning at 600 revolutions per minute, this system presents 3-D images in an addressable 10 cubic feet of cylindrical volume. This report discusses the four basic disciplines used in development of the Improved Second-Generation 3-D Volumetric Display System and provides examples of practical applications of the technology.

DTIC

*Cylindrical Bodies; Display Devices; Laser Beams; Lasers; Military Technology*

**19990009062** Logistics Management Inst., McLean, VA USA

**Characterizing Commercial Market Effects on Military Electronics Development Program Costs: An Analytical Framework Final Report**

Clippinger, Anthony L., Logistics Management Inst., USA; Gaier, Eric M., Logistics Management Inst., USA; Sep. 1998; 38p; In English

Contract(s)/Grant(s): DASW01-95-C-0019

Report No.(s): AD-A355679; LMI-PA805T1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

OSD(PA&E) tasked LMI to study how defense acquisition reform, advanced business processes and new high technologies have affected how products are developed for DoD and what methods should be used to estimate the costs of those developments. LMI first looked at the defense electronics sector using Global Positioning System (GPS) receivers as an analog. A portion of that investigation looked at the influence of the commercial marketplace on what DoD pays for product development. LMI developed an economics-based analytical model that characterizes how the existence of commercial market potential for a new product impacts industry interactions with DoD. The model, which uses a two-stage game algorithm, captures the motivations and incentives of the various players involved in a competitive bid for a DoD product development contract. It provides DoD with an analytical framework for assessing contractor bids for development programs with dual military and commercial potential. This report also contains a brief market description and analysis of the GPS receiver industry that provides some insights into how the LMI model applies in that domain.

DTIC

*Global Positioning System; Mathematical Models; Economics*

**34**

**FLUID MECHANICS AND HEAT TRANSFER**

*Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling. For related information see also 02 Aerodynamics and 77 Thermodynamics and Statistical Physics.*

**19990008518** NASA Lewis Research Center, Cleveland, OH USA

**Experimental Study of Boundary Layer Behavior in a Simulated Low Pressure Turbine**

Shyne, Rickey J., NASA Lewis Research Center, USA; Oct. 1998; 162p; In English

Contract(s)/Grant(s): RTOP 523-26-33

Report No.(s): NASA/TM-1998-208503; NAS 1.15:208503; E-11305; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

A detailed investigation of the flow physics occurring on the suction side of a simulated Low Pressure Turbine (LPT) blade was performed. A contoured upper wall was designed to simulate the pressure distribution of an actual LPT blade onto a flat plate. The experiments were carried out at Reynolds numbers of 100,000 and 250,000 with three levels of freestream turbulence. Free-stream turbulence levels ranging from 0.8% to 3% was used in this experiment. Smoke-wire flow visualization data was used to confirm that the boundary layer was separated and formed a bubble. Hot-wires (single and x-wire) and surface mounted hot-film gases and static pressure taps were used to map the flowfield. The transition process over the separated flow region is observed to be similar to a laminar free shear layer flow with the formation of a large coherent eddy structure. For each condition, the locations defining the separation bubble were determined by careful examination of pressure and mean velocity profile data. Transition onset location and length determined from intermittency profiles decrease as freestream turbulence levels increase. Additionally, the length and height of the laminar separation bubbles were observed to be inversely proportional to the levels of freestream turbulence.

Author

*Fluid Dynamics; Flow Visualization; Low Pressure; Turbines; Boundary Layer Separation; Turbulent Flow; Boundary Layer Transition; Turbulent Boundary Layer; Wind Tunnel Tests; Flow Measurement*

**19990008607** NASA Lewis Research Center, Cleveland, OH USA

**Skin Friction Reduction by Micro-Blowing Technique**

Hwang, Danny P., Inventor, NASA Lewis Research Center, USA; Sep. 08, 1998; 16p; In English

Patent Info.: Filed 1 Dec. 1995; NASA-Case-LEW-15920-1; US-Patent-5,803,410; US-Patent-Appl-SN-566211; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A system and method for reducing skin friction of an object in relative motion to a fluid. A skin forming a boundary between the object and the fluid, the skin having holes through which micro-blowing of air is blown and a transmitting mechanism for



transmitting air through the skin. The skin has an inner layer and an outer layer. the inner layer being a low permeable porous sheet, the outer layer being a plate having high aspect ratio high porosity. and small holes. The system may further include a suction apparatus for suctioning air from the outer layer. The method includes the steps of transmitting air through the inner layer and passing the air transmitted through the inner layer to the outer layer. The method may further include the step of bleeding air off the outer layer using the suction apparatus.

Author

*Skin Friction; Friction Reduction; Holes (Mechanics); Porosity; Boundary Layer Control; Suction*

**19990008658** Louisiana State Univ., Mechanical Engineering Dept., Baton Rouge, LA USA

**Direct Numerical Simulation of a Coolant Jet in a Periodic Crossflow Final Report**

Sharma, Chirdeep, Louisiana State Univ., USA; Acharya, Sumanta, Louisiana State Univ., USA; Oct. 1998; 54p; In English; International Mechanical Engineering Congress and Exposition, 15-20 Nov. 1998, Anaheim, CA, USA; Original contains color illustrations

Contract(s)/Grant(s): NAG3-1641; RTOP 538-12-10

Report No.(s): NASA/CR-1998-208674; NAS 1.26:208674; E-11402; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A Direct Numerical Simulation of a coolant jet injected normally into a periodic crossflow is presented. The physical situation simulated represents a periodic module in a coolant hole array with a heated crossflow. A collocated finite difference scheme is used which is fifth-order accurate spatially and second-order accurate temporally. The scheme is based on a fractional step approach and requires the solution of a pressure-Poisson equation. The simulations are obtained for a blowing ratio of 0.25 and a channel Reynolds number of 5600. The simulations reveal the dynamics of several large scale structures including the Counter-rotating Vortex Pair (CVP), the horse-shoe vortex, the shear layer vortex, the wall vortex and the wake vortex. The origins and the interactions of these vortical structures are identified and explored. Also presented are the turbulence statistics and how they relate to the flow structures.

Author

*Gas Turbines; Reynolds Number; Poisson Equation; Finite Difference Theory; Direct Numerical Simulation; Counter Rotation*

**19990008704** Michigan State Univ., Dept. of Mechanical Engineering, East Lansing, MI USA

**Application of Molecular Tagging Diagnostics to Turbulent Mixing Enhancement and Control Studies Final Report, 1 Jun. 1995 - 31 May 1998**

Koochesfahani, Manoochehr M., Michigan State Univ., USA; Aug. 31, 1998; 15p; In English

Contract(s)/Grant(s): F49620-95-1-0391; AF Proj. 3484

Report No.(s): AD-A354558; AFRL-SR-BL-TR-98-0674; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Molecular Tagging Velocimetry (MTV) was used to study vorticity dynamics in several flows under investigation for mixing enhancement and control. The evolution of streamwise vorticity, responsible for a large increase in mixing in a confined wake flow, was measured. It was found that the streamwise vorticity has a peak value in excess of 70% of the peak spanwise vorticity. The MTV technique was extended to allow simultaneous whole field measurements of the velocity and a passive scalar on the basis of molecular tagging diagnostics. This new approach also offers a new capability for simultaneous flow visualization and vorticity mapping. The application of MTV to the study of unsteady separation resulted in boundary layer resolved measurements of flow separation in the vortex ring/wall interaction and dynamic stall over a pitching airfoil. The measurements of flow separation over a pitching airfoil, believed to be the first boundary layer resolved measurement of this phenomenon, show that the process of boundary layer separation occurs over a shorter time scale, and is more eruptive, than that captured by the computations to date.

DTIC

*Molecules; Diagnosis; Turbulent Mixing; Turbulent Flow; Jet Mixing Flow; Marking*

**19990008721** Michigan Univ., Ann Arbor, MI USA

**Secondary Breakup and Turbulence Interactions of Drops Final Report, 15 Jul. 1995 - 14 Jul 1998**

Chen, J. H.; Chou, W. H.; Dai, Z.; Wu, J. S.; Faeth, G. M.; Jul. 1998; 215p; In English

Contract(s)/Grant(s): F49620-95-1-0364; AF Proj. 2308

Report No.(s): AD-A354835; GDL/GMF-98-01; AFRL-SR-BL-TR-98-0677; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Experimental studies of two types of drop/gas interactions that are important in the near injector, dense region of sprays were carried out, as follows: (1) secondary drop breakup, which tends to control transport processes in dense sprays; and (2) turbulence generation by rapidly moving drops in gas environments, which tends to control interphase turbulence production in dense sprays.

The drop breakup measurements showed that breakup should be treated as a rate process rather than by jump conditions in some instances and provided data about the temporal properties of breakup in the important bag and shear breakup regimes. The turbulence generation measurements showed that homogeneous dispersed flows of drops (particles) in gases consist of particle wake disturbances embedded in relatively large interwake turbulence fields and provided data about the particle wake properties and the overall turbulence properties of these flows for various particle sizes and fluxes.

DTIC

*Drop Size; Embedding; Flow Measurement; Injectors; Sprayers*

**19990008730** Naval Postgraduate School, Dept. of Mechanical Engineering, Monterey, CA USA

**An Experimental Investigation of Vortex Breakdown in Tubes at High Reynolds Numbers**

Novak, Francis G.; Sep. 1998; 336p; In English

Report No.(s): AD-A354947; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

This thesis deals with non-cavitating swirling flows with vortex breakdown in various tubes. Phenomenological and quantitative investigations were carried out at Reynolds numbers as high as 300,000. It was shown that a high  $Re(D)$  vortex transitions to its new state (breaks down) via a rapidly spinning spiral form, as demonstrated with 4,000 frame per second video, short exposure time (6 ns) imaging, and Digital Particle Image Velocimetry. of the known types, the spiral emerges as the fundamental breakdown form and the axisymmetric bubble may now be regarded as a relatively low  $Re(D)$  occurrence that is bypassed at sufficiently high  $Re(D)$ . Some new phenomena were observed at high  $Re(D)$ : Extremely rapid spiral rotation (over 1,000 revolutions per second), core bifurcation, and changes in the sense of the spiral windings. Familiar features of breakdowns, such as the transition from a jet-like to wake-like axial velocity profile and the rapidly expanding vortex core, were observed in extensive time averaged velocity and turbulence results ascertained with Laser Doppler Velocimetry. However, a mean stagnation point and recirculation were absent in the highest  $Re(D)$  flow. The core meandering and stagnation point darting in the turbulent flow field were quantified and discussed in detail.

DTIC

*High Reynolds Number; Particle Image Velocimetry; Laser Doppler Velocimeters; Flow Distribution*

**19990008741** Kagoshima Univ., Faculty of Engineering, Japan

**Heat Transfer and Flow Characteristics Behind Cylinders (Effects of Scale of Free-Stream Turbulence and Cylinder Size)**

Torii, Shuichi, Kagoshima Univ., Japan; Fuse, Hajime, Kagoshima Univ., Japan; The Research Reports of The Faculty of Engineering, Kagoshima University; Sep. 1993; ISSN 0451-212X, No. 35, pp. 13-19; In Japanese; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental study was conducted on heat transfer from slightly heated circular cylinders in cross flow. Emphasis was placed on the combined influence of the scale of free-stream turbulence and the diameter of the cylinder on the rate of heat transfer at the rear stagnation point. by using a hot-wire anemometer, spectrum analysis of the anemometer signal with a Fourier analyzer is employed to investigate the separated shear layer formed behind the circular cylinder. The Nusselt number at the rear stagnation point varies with the scale ratio of turbulence and cylinder diameter, although the Reynolds number is the same. Corresponding streamwise profile of the separated shear layer is also influenced. The laminar-to-turbulent transition region moves in the streamwise direction because of a variation of the scale ratio. It was discovered that the heat transfer characteristics behind cylinders are affected by the scale ratio, and are closely related to the streamwise movement of the region of transition to turbulence in the separated shear layer.

Author

*Flow Characteristics; Circular Cylinders; Free Flow; Turbulence; Scale (Ratio); Cross Flow; Aerodynamic Heat Transfer; Aerodynamic Characteristics*

**19990008839** National Aerospace Lab., Tokyo, Japan

**Navier-Stokes Simulation and Linear Stability Analysis for a Boundary Layer on the Swept Cylinder**

Nomura, T., National Aerospace Lab., Japan; Feb. 1997; 22p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108912; NAL-TR-1321; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Techniques to delay laminar turbulent transition on the wing, called laminar flow control, are important for drag reduction of high speed civil transports cruising at supersonic speeds. The onset of transition is numerically predicted by computation of a boundary layer flow, linear stability analysis for the flow and integration of the spatial growth rates obtained by the analysis. Boundary layer flows used to predict the transition have been generally computed with boundary layer codes. In this paper, a Navier Stokes code is constructed for the computation. The supersonic flow around an infinite swept cylinder is computed with three



types of grids which have different resolutions. The accuracy of the Navier Stokes code is tested by comparing velocity and temperature profiles in the boundary layer obtained with these three grids. Furthermore, linear stability analysis for the attachment line boundary layer is performed.

NTIS

*Navier-Stokes Equation; Stability Tests; Cylindrical Bodies; Boundary Layer Transition; Laminar Flow; Turbulent Flow; Swept Wings; Laminar Boundary Layer; Flow Stability*

**19990008847** National Aerospace Lab., Tokyo, Japan

**Prandtl-Meyer Type Expansion Wave in Axisymmetric Supersonic Flow**

Nomizo, K., National Aerospace Lab., Japan; Tani, T., National Aerospace Lab., Japan; Sep. 1997; 24p; In Japanese; Portions of this document are not fully legible

Report No.(s): PB99-108896; NAL-TR-1332; Copyright Waived; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

In a two-dimensional flow, the authors have an exact analytical form for Prandtl Meyer waves so the basis of the characteristic method is well established. But in three dimensional axially symmetric flow, no exact solution exists for such expansion waves. In this report, the authors compared a new type of similar solution of linearized flow with the result by the characteristic method. This results is used to study the periodic structure of an exhaust jet.

NTIS

*Axisymmetric Flow; Supersonic Flow; Prandtl-Meyer Expansion; Elastic Waves*

**19990008891** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Effects of Helicity on Lagrangian and Eulerian Time Correlations in Turbulence Final Report**

Rubinstein, Robert, Institute for Computer Applications in Science and Engineering, USA; Zhou, Ye, Institute for Computer Applications in Science and Engineering, USA; Nov. 1998; 8p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-1998-208737; NAS 1.26:208737; ICASE-98-49; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Taylor series expansions of turbulent time correlation functions are applied to show that helicity influences Eulerian time correlations more strongly than Lagrangian time correlations: to second order in time, the helicity effect on Lagrangian time correlations vanishes, but the helicity effect on Eulerian time correlations is nonzero. Fourier analysis shows that the helicity effect on Eulerian time correlations is confined to the largest inertial range scales. Some implications for sound radiation by swirling flows are discussed.

Author

*Lagrangian Function; Fourier Analysis; Sound Waves; Time Functions*

**19990008951** NASA Lewis Research Center, Cleveland, OH USA

**Evaluation of Boundary Conditions for the Gust-Cascade Problem**

Hixon, R., NASA Lewis Research Center, USA; Shih, S.-H., NASA Lewis Research Center, USA; Mankbadi, R. R., NASA Lewis Research Center, USA; Nov. 1998; 34p; In English

Contract(s)/Grant(s): NCC3-531; RTOP 523-36-13

Report No.(s): NASA/CR-1998-208671; NAS 1.26:208671; E-11395; ICOMP-98-06; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using a high-order accuracy finite-difference time-domain algorithm, the acoustic scattering from a flat-plate cascade is computed. Keeping the grid and time step fixed, the effect of four different boundary conditions on the accuracy and stability of the computed solution is compared.

Author

*Acoustic Scattering; Boundary Conditions; Finite Difference Theory; Flat Plates*

**19990008990** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Pattern Image Processing Measurements and Application to the Flow in a Rotating Impeller**

Hayami, Hiroshi, Kyushu Univ., Japan; Chen, Dexin, Kyushu Univ., Japan; Koso, Toru, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 175-184; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Fluid flow in a small model of a Francis-type pump turbine was visualized by means of a tracer method and was photographed using a video camera rotating with the runner. Several kinds of pattern image processing measurements are reviewed and one method based on a correlation method is applied to get the relative velocity vectors of the fluid flow in a rotating impeller from the video images. The problems which occur in the image processing measurement and the countermeasures are discussed.

Author

*Image Processing; Fluid Flow; Rotation; Impellers; Turbine Pumps; Tracers; Photography*

**19990008993** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Effect of Basset Term on the Analysis of the Particle Motion in Oscillating Flows**

Yamamoto, Hiromi, Kyushu Univ., Japan; Koso, Toru, Kyushu Univ., Japan; Hayami, Hiroshi, Kyushu Univ., Japan; Hirata, Keiichirou, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 141-147; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The motion of small particle in sinusoidal oscillating air flows is investigated numerically by using the Tchen equation with the Crank Nicholson method. The velocities of water particles whose diameter are 1, 10 and 100 microns are calculated in oscillating air flows in the frequency range from 1 Hz to 1 MHz. The result of analysis indicates that the amplitudes of particle velocity which are deduced including Basset term differ from those without Basset term, and the maximum error in the amplitude of particle velocity is 4% of the amplitude of fluid velocity at non-dimensional frequency  $ftau(sub p)$  of 0.3. This error is reduced as the non dimensional frequency  $ftau(sub p)$  increased as well as decreased from 0.3, and the frequency range which the error is less than 2% is  $ftau(sub p)$  less than or equal to 0.08 or  $ftau(sub p)$  greater than or equal to 2.0.

Author

*Particle Motion; Oscillating Flow; Air Flow; Sine Waves*

**19990008999** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Condensation and Evaporation of Refrigerants in a Plate Fin Heat Exchanger**

Yara, Tomoyasu, Kyushu Univ., Japan; Koyama, Shigeru, Kyushu Univ., Japan; Fujii, Tetsu, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 61-69; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental study of condensation and evaporation of pure and mixed refrigerants in a plate fin heat exchanger was carried out. Pure refrigerants of HCFC22 and HFC134a and binary refrigerant mixtures of HCFC22/CFC114 were tested in the ranges of heat flux from 10 to 65 [kW/m<sup>2</sup>] and of mass velocity from 50 to 100 [kg/(sq m s)]. It is clarified that the heat transfer characteristics of condensation and evaporation in the experimental range are not affected by shear stress, but controlled by gravity force. The experimental values of local Nusselt number of both condensation and evaporation of pure refrigerants are ten times higher than the values predicted from a semi empirical equation for free convection condensation heat transfer of pure refrigerant inside a vertical tube, while the experimental values of refrigerant mixtures are lower than the predicted values and the difference depends on molar fraction.

Author

*Evaporation; Refrigerants; Fins; Heat Exchangers; Condensation*

**19990009001** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Numerical Calculation of Transient Response of Natural Convection in a Cavity**

Hirano, Hiroyuki, Kyushu Univ., Japan; Ozoe, Hiroyuki, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 45-52; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents the effect of some methods for the numerical solution of natural convection in a cavity at  $P\text{-}\gamma=0.7$  and  $G\text{-}\gamma=10(\exp 6)$  on the transient responses and converged values of stream function and temperature. The governing equation was discretized by explicit, Crank Nicolson and fully implicit methods. ADI, Line by Line and Incomplete LU decomposition conjugate residual (CR) algorithms were used to solve the discretization equation by fully implicit method. Further, the effect of time interval and grid size on the results was also investigated. It was concluded that all solution methods agree as time interval and grid size approach 0. ADI is the most reasonable method in this study, and CR is most stable in fully implicit methods for a given time interval.

Author

*Transient Response; Free Convection; Crank-Nicolson Method; Discretization (Mathematics); Decomposition; Finite Difference Theory; Cavitation Flow*

**19990009004** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Numerical Simulation of Oscillatory Axisymmetric Marangoni Convection in Small Liquid Bridge**

Yasuhiro, Shoichi, Kyushu Univ., Japan; Imaishi, Nobuyuki, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 23-33; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The present numerical simulation explores a thermal-convection mechanism for oscillatory Marangoni convection in a small liquid bridge for a fluid of Prandtl number 3.34. In this work we developed a stability diagram for the critical Marangoni number separating the steady from the time-dependent flow states as a function of the aspect ratio between 1.0 and 3.0 for adiabatic melt surface. These results obtained numerically are compared with the critical Marangoni numbers for axisymmetric oscillatory convection predicted via the energy method by Shen et. al.. We also discussed the effect of heat transfer through the melt surface on the critical Marangoni number.

Author

*Oscillations; Marangoni Convection; Computerized Simulation; Liquid Bridges; Heat Transfer*

**19990009036** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Natural Convection Heat Transfer from an Array of Vertical Parallel Plates with Protruding and Discrete Heat Sources: Prediction of Protrusion Surface Temperature**

Fujii, Motoo, Kyushu Univ., Japan; Gima, Satoru, Kyushu Univ., Japan; Tomimura, Toshio, Kyushu Univ., Japan; Zhang, Xing, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 119-129; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

As a fundamental study of natural air cooling of IC boards, natural convection heat transfer to air from an array of vertical parallel plates with protruding and discrete heat sources is studied theoretically and experimentally. Two dimensional Navier-Stokes and energy equations including heat conduction through the plates and heat sources are numerically solved under the conditions of modified Grashof number  $Gr=2.3 \times 10(\exp 3)$  approx.  $= 8.8 \times 10(\exp 5)$  and aspect ratio  $L= l/h = 8-30$ . The numerical solutions agree well with the experimental values except for the large aspect ratio  $L=30$  where the three-dimensional effects become significant. A correlation expression for the local Nusselt number is proposed which can predict the protrusion surface temperature within 20% error. Also is discussed the estimation method of the maximum temperature in the protrusion.

Author

*Free Convection; Convective Heat Transfer; Parallel Plates; Heat Sources; Surface Temperature*

## 35

### INSTRUMENTATION AND PHOTOGRAPHY

*Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Aircraft Instrumentation, and 19 Space Instrumentation.*

**19990008486** NASA Lewis Research Center, Cleveland, OH USA

**Self Calibration of a 2-wavelength Pyrometer**

Ng, Daniel, NASA Lewis Research Center, USA; Nov. 1998; 11p; In English; Original contains color illustrations

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA/TM-1998-208808; E-11398; NAS 1.15:208808; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Pyrometers require calibrations to determine their instrument constants before they can be used in remote temperature measurements. These constants reflect the combined effects of detector response, the transmissivities of intervening optical media (windows and gases) and the emissivity of the measured surface. We describe here the principal and the demonstration of self calibrating 2-wavelength pyrometer.

Author

*Calibrating; Pyrometers; Wavelengths*

**19990008488** NASA Langley Research Center, Hampton, VA USA

**Simultaneous Luminescence Pressure and Temperature Mapping**

Buck, Gregory M., Inventor, NASA Langley Research Center, USA; Oct. 06, 1998; 18p; In English; Continuation of abandoned US-Patent-Appl-SN-492686, filled 20 Jun. 1995

Patent Info.: Filed 7 Oct. 1996; NASA-Case-LAR-15297-2; US-Patent-5,818,057; US-Patent-Appl-SN-726993; US-Patent-Appl-SN-492686; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A simultaneous luminescence pressure and temperature mapping system is developed including improved dye application techniques for surface temperature and pressure measurements from 5 torr to 1000 torr with possible upgrade to from 0.5 torr to several atmospheres with improved camera resolution. Adsorbed perylene dye on slip-cast silica is pressure (oxygen) sensitive and reusable to relatively high temperatures (-150 C). Adsorbed luminescence has an approximately linear color shift with temperature, which can be used for independent temperature mapping and brightness pressure calibration with temperature.

Official Gazette of the U.S. Patent and Trademark Office

*Luminescence; Pressure Measurement; Surface Temperature; Mapping; Dyes*

**19990008544** NASA Johnson Space Center, Houston, TX USA

**Fiber-Optic Chemiluminescent Biosensors for Monitoring Aqueous Alcohols and Other Water Quality Parameters**

Verostko, Charles E., Inventor, NASA Johnson Space Center, USA; Atwater, James E., Inventor, NASA Johnson Space Center, USA; Akse, James R., Inventor, NASA Johnson Space Center, USA; DeHart, Jeffrey L., Inventor, NASA Johnson Space Center, USA; Wheeler, Richard R., Inventor, NASA Johnson Space Center, USA; Aug. 11, 1998; 26p; In English

Patent Info.: Filed 28 Jun. 1995; NASA-Case-MS-C-22605-1-SB; US-Patent-5,792,621; US-Patent-Appl-SN-496230; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A "reagentless" chemiluminescent biosensor and method for the determination of hydrogen peroxide, ethanol and D-glucose in water is disclosed. An aqueous stream is basified by passing it through a solid phase base bed. Luminol is then dissolved in the basified effluent at a controlled rate. Oxidation of the luminol is catalyzed by the target chemical to produce emitted light. The intensity of the emitted light is detected as a measure of the target chemical concentration in the aqueous stream. The emitted light can be transmitted by a fiber optic bundle to a remote location from the aqueous stream for a remote reading of the target chemical concentration.

Official Gazette of the U.S. Patent and Trademark Office

*Bioinstrumentation; Chemiluminescence; Fiber Optics; Ethyl Alcohol; Hydrogen Peroxide; Glucose*

**19990008577** NASA Langley Research Center, Hampton, VA USA

**Variable and Fixed Frequency Pulsed Phase Locked Loop**

Froggatt, Mark E., Inventor, NASA Langley Research Center, USA; Nov. 24, 1998; 10p; In English; Provisional US-Patent-Appl-SN-013216, filed 2 Feb. 1996

Patent Info.: Filed 24 Jan. 1997; NASA-Case-LAR-14840-1; US-Patent-5,841,032; US-Patent-Appl-SN-792909; US-Patent-Appl-SN-013216; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A measuring apparatus uses a variable and fixed frequency pulsed phase locked loop to measure the phase shift caused by a delay path to a high degree of accuracy. This accurate measurement of total phase change through greater than 360 degrees allows the apparatus to measure strain in bolts or other materials. The apparatus is able to identify features on a waveform through pattern recognition, and measure untracked phase differences with better reliability than simple thresholding techniques permit.

Official Gazette of the U.S. Patent and Trademark Office

*Phase Locked Systems; Phase Shift; Measuring Instruments; Waveforms; Analog to Digital Converters; Phase Detectors*

**19990008581** NASA Langley Research Center, Hampton, VA USA

**Method of Forming a Hot Film Sensor System on a Model**

Tran, Sang Q., Inventor, NASA Langley Research Center, USA; Aug. 04, 1998; 6p; In English

Patent Info.: Filed 11 Mar. 1996; NASA-Case-LAR-14732-1; US-Patent-5,789,020; US-Patent-Appl-SN-613305; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A method of forming a hot film sensor directly on a model is provided. A polyimide solution is sprayed onto the model. The model so sprayed is then heated in air. The steps of spraying and heating are repeated until a polyimide film of desired thickness is achieved on the model. The model with the polyimide film thereon is then thoroughly dried in air. One or more hot film sensors and corresponding electrical conducting leads are then applied directly onto the polyimide film.

Official Gazette of the U.S. Patent and Trademark Office

*Thin Films; Deposition; Forming Techniques; Measuring Instruments; Polyimides*

**19990008587** NASA Langley Research Center, Hampton, VA USA

**Apparatus and Method for Measuring Strain in Bragg Gratings**

Froggatt, Mark E., Inventor, NASA Langley Research Center, USA; Aug. 25, 1998; 12p; In English

Patent Info.: Filed 27 Feb. 1997; NASA-Case-LAR-15318-1; US-Patent-5,798,521; US-Patent-Appl-SN-806732; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An apparatus and method for measuring strain of gratings written into an optical fiber is disclosed. Optical radiation is transmitted over a plurality of contiguous predetermined wavelength ranges into a reference optical fiber network and an optical fiber network under test to produce a plurality of reference interference fringes and measurement interference fringes, respectively. The reference and measurement fringes are detected and sampled such that each sampled value of the reference and measurement fringes is associated with a corresponding sample number. The wavelength change of the reference optical fiber, for each sample number, due to the wavelength of the optical radiation is determined. Each determined wavelength change is matched with a corresponding sampled value of each measurement fringe. Each sampled measurement fringe of each wavelength sweep is transformed into a spatial domain waveform. The spatial domain waveforms are summed to form a summation spatial domain waveform that is used to determine location of each grating with respect to a reference reflector. A portion of each spatial domain waveform that corresponds to a particular grating is determined and transformed into a corresponding frequency spectrum representation. The strain on the grating at each wavelength of optical radiation is determined by determining the difference between the current wavelength and an earlier, zero-strain wavelength measurement.

Official Gazette of the U.S. Patent and Trademark Office

*Strain Measurement; Bragg Gratings; Optical Fibers; Strain Rate*

**19990008591** NASA Langley Research Center, Hampton, VA USA

**Strain Insensitive Optical Phase Locked Loop**

Egalon, Claudio O., Inventor, NASA Langley Research Center, USA; Rogowski, Robert S., Inventor, NASA Langley Research Center, USA; Jul. 14, 1998; 12p; In English

Patent Info.: Filed 23 Apr. 1996; NASA-Case-LAR-15159-1-SB; US-Patent-5,780,844; US-Patent-Appl-SN-644655; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A strain sensor uses optical fibers including strain insensitive portions and a strain sensitive portion. The optical fibers form a sensitive arm of an optical phase locked loop (OPLL). The use of the OPLL allows for multimode optical fiber to be used in a strain insensitive configuration. Only strain information for the strain sensitive portion is monitored rather than the integrated strain measurements commonly made with optical fiber sensors.

Official Gazette of the U.S. Patent and Trademark Office

*Optical Fibers; Phase Locked Systems; Strain Measurement*

**19990008633** NASA Marshall Space Flight Center, Huntsville, AL USA

**Breakdown Features of Various Microstrip-Type Gas Counter Designs and Their Improvements**

Peskov, V., NASA Marshall Space Flight Center, USA; Ramsey, B. D., NASA Marshall Space Flight Center, USA; Fonte, P., Coimbra Univ., Portugal; Conference Proceedings: Proceedings of IEEE Transactions on Nuclear Science; 1998; 1p; In English; Transactions on Nuclear Science, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

Breakdown mechanisms and spurious pulses, the precursors to some breakdowns, were studied experimentally for both uncoated and coated Microstrip Gas Counters (MSGCs) of different geometries, as well as for MicroGap Counters (MGCs) and for the "Compteur A Trou" (CAT). It was found that in all cases the breakdowns occurred through surface streamers, although the exact mechanism of streamer formation depended on the particular detector design. Based on these studies, new designs of microstrip detectors, in which the role of the substrate was minimized, were elaborated and tested. In some of these detectors, especially with large pitches (greater than 2mm), gains up to  $2-3 \times 10^{(exp 5)}$  were achieved together with good rate characteristics. The ultimate gain limit in all geometries was still set by spark-inducing streamers which appeared at some critical charge density in the avalanche. To avoid this, and particularly to enhance the performance of small-pitch MSGCs, preamplification structures can be used. Utilizing a parallel plate avalanche chamber as a front end to an MSGC resulted in an overall gain of approximately  $10^{(exp 6)}$ , limited in this case only by charge saturation.

Author

*Coatings; Detectors; Sparks; Counters*



**19990008638** NASA Marshall Space Flight Center, Huntsville, AL USA

**A Study of Breakdown Limits in Microstrip Gas Counters with Preamplification Structures**

Fonte, P., Coimbra Univ., Portugal; Peskov, V., NASA Marshall Space Flight Center, USA; Ramsey, B. D., NASA Marshall Space Flight Center, USA; Nuclear Instruments and Methods for Physical Research A; 1998; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

We have studied the charge and breakdown limits of Microstrip Gas Counters (MSGCs) with 2 different preamplification structures: the Gas Electron Multiplier (GEM) and the Parallel-Plate Avalanche Counter (PPAC). It was found that in both cases the breakdown limit was increased by 1-2 orders of magnitude compared to the bare MSGC that this is due to the spread of the primary electron cloud during pre-amplification. This spreading reduces the charge density in the final MSGC avalanche, permitting much higher total gains before streamers form. The real practical gain limitations in these two-stage detectors arose not from sparking, but from a loss of proportionality due to space charge effects.

Author

*Counters; Space Charge; Electric Charge; Amplification; Photomultiplier Tubes*

**19990008641** Range Commanders Council, Telemetry Group, White Sands Missile Range, NM USA

**Digital Data Acquisition and On-Board Recording Standard**

Jun. 1998; 95p; In English

Report No.(s): AD-A355122; IRIG-STANDARD-107-98; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This document is a technical standard for use in developing packetized on-board recording systems and has been prepared by the Range Commanders Council (RCC) Telemetry Group (TG). The packet telemetry concept described herein is the baseline for on-board recording of missions that require cross support between organizations. This standard establishes a common framework and provides a common basis for the data structures of on-board recording data.

DTIC

*Data Acquisition; Data Recording; Digital Data; Recording Instruments*

**19990008659** NASA Lewis Research Center, Cleveland, OH USA

**Microfabricated Chemical Sensors for Safety and Emission Control Applications**

Hunter, G. W., NASA Lewis Research Center, USA; Neudeck, P. G., NASA Lewis Research Center, USA; Chen, L.-Y., NASA Lewis Research Center, USA; Knight, D., Cortez 3 Service Corp., USA; Liu, C. C., Case Western Reserve Univ., USA; Wu, Q. H., Case Western Reserve Univ., USA; Nov. 1998; 14p; In English; 17th; Digital Avionics Systems, 31 Oct. - 6 Nov. 1998, Bellevue, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 523-26-13

Report No.(s): NASA/TM-1998-208816; E-11418; NAS 1.15:208816; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Chemical sensor technology is being developed for leak detection, emission monitoring, and fire safety applications. The development of these sensors is based on progress in two types of technology: 1. Micromachining and microfabrication (MEMS-based) technology to fabricate miniaturized sensors. 2. The development of high temperature semiconductors, especially silicon carbide. Using these technologies, sensors to measure hydrogen, hydrocarbons, nitrogen oxides, carbon monoxide, oxygen, and carbon dioxide are being developed. A description is given of each sensor type and its present stage of development. It is concluded that microfabricated sensor technology has significant potential for use in a range of aerospace applications.

Author

*Detection; Fabrication; Microelectromechanical Systems; Micromachining; Nitrogen Oxides; Progress; Silicon Carbides; Technology Assessment*

**19990008662** NASA Lewis Research Center, Cleveland, OH USA

**Self Calibration of a 2-wavelength Pyrometer**

Ng, Daniel, NASA Lewis Research Center, USA; Nov. 1998; 10p; In English

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA/TM-1998-208808; E-11398; NAS 1.15:208808; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Pyrometers require calibrations to determine their instrument constants before they can be used in remote temperature measurements. These constants reflect the combined effects of detector response, the transmissivities of intervening optical media



(windows and gases) and the emissivity of the measured surface. We describe here the principal and the demonstration of self calibrating 2-wavelength pyrometer.

Author

*Pyrometers; Temperature Measurement*

**19990008768** NASA Lewis Research Center, Cleveland, OH USA

**Comparison of Computational, Model and Experimental, Example Trained Neural Networks for Processing Speckled Fringe Patterns**

Decker, A. J., NASA Lewis Research Center, USA; Fite, E. B., NASA Lewis Research Center, USA; Thorp, S. A., NASA Lewis Research Center, USA; Mehmed, O., NASA Lewis Research Center, USA; Nov. 1998; 12p; In English; Optical Technology and Image Processing in Fluid, Thermal and Combustion Flow, 7-9 Dec. 1998, Yokohama, Japan; Sponsored by International Society for Optical Engineering, USA

Contract(s)/Grant(s): RTOP 519-30-53

Report No.(s): NASA/TM-1998-208814; E-11413; NAS 1.15:208814; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The responses of artificial neural networks to experimental and model-generated inputs are compared for detection of damage in twisted fan blades using electronic holography. The training-set inputs, for this work, are experimentally generated characteristic patterns of the vibrating blades. The outputs are damage-flag indicators or second derivatives of the sensitivity-vector-projected displacement vectors from a finite element model. Artificial neural networks have been trained in the past with computational-model-generated training sets. This approach avoids the difficult inverse calculations traditionally used to compare interference fringes with the models. But the high modeling standards are hard to achieve, even with fan-blade finite-element models.

Author

*Mathematical Models; Comparison; Experimentation; Neural Nets; Models*

**19990008856** NASA Lewis Research Center, Cleveland, OH USA

**A Hazardous Gas Detection System for Aerospace and Commercial Applications**

Hunter, G. W., NASA Lewis Research Center, USA; Neudeck, P. G., NASA Lewis Research Center, USA; Chen, L.-Y., NASA Lewis Research Center, USA; Makel, D. B., Makel Engineering, Inc., USA; Liu, C. C., Case Western Reserve Univ., USA; Wu, Q. H., Case Western Reserve Univ., USA; Knight, D., Cortez 3 Service Corp., USA; Nov. 1998; 14p; In English; 34th; Propulsion, 12-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 254-02-0A

Report No.(s): NASA/TM-1998-208817; E-11419; NAS 1.15:208817; AIAA Paper 98-3614; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The detection of explosive conditions in aerospace propulsion applications is important for safety and economic reasons. Microfabricated hydrogen, oxygen, and hydrocarbon sensors as well as the accompanying hardware and software are being developed for a range of aerospace safety applications. The development of these sensors is being done using MEMS (Micro ElectroMechanical Systems) based technology and SiC-based semiconductor technology. The hardware and software allows control and interrogation of each sensor head and reduces accompanying cabling through multiplexing. These systems are being applied on the X-33 and on an upcoming STS-95 Shuttle mission. A number of commercial applications are also being pursued. It is concluded that this MEMS-based technology has significant potential to reduce costs and increase safety in a variety of aerospace applications.

Author

*Gas Detectors; Hazards; Computer Programs; Hardware; Aerospace Safety*

**19990008950** NASA Lewis Research Center, Cleveland, OH USA

**Remote Heat Flux Using a Self Calibration Multiwavelength Pyrometer and a Transparent Material**

Ng, Daniel, NASA Lewis Research Center, USA; Nov. 1998; 12p; In English

Contract(s)/Grant(s): RTOP 523-21-13

Report No.(s): NASA/TM-1998-208809; NAS 1.15:208809; E-11399; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A self calibrating multiwavelength pyrometer was used to conduct remote heat flux measurements using a transparent sapphire disk by determining the sapphire disk's front and back surface temperatures. Front surface temperature (Tfs) was obtained from detection of surface emitted radiation at long wavelengths ( $k = 6 \text{ gm}$ ). Back surface temperature (Tbs) was obtained from

short wavelength (1 to 5  $\mu\text{m}$ ) radiation transmitted through the sapphire disk. The thermal conductivity of the sapphire disk and the heat transfer coefficients  $h_1$  and  $h_2$  of its surfaces are determined experimentally. An analysis of the heat flux measurement is presented.

Author

*Heat Flux; Heat Transfer Coefficients; Pyrometers; Remote Sensing; Surface Temperature; Thermal Conductivity*

**19990008967** Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA

**Photonic A/D Converters for Wideband and High-Dynamic-Range Performance**

Twichell, J. C.; Lemnios, Z. J.; Dickerson, C. E.; Jan. 1998; 8p; In English

Report No.(s): AD-A355857; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Navy TBMD AEGIS ships will be required to perform radar tracking and exoatmospheric discrimination against future TBM threats that will have significantly greater range, higher velocity, and lower radar cross section than the current predominate threat. A significant contributor to current radar tracking and discrimination limitations is the downconversion chain to intermediate frequency (IF) and the analog-to-digital (A/D) conversion. Conventional multistage downconversion receivers are limited in dynamic range, linearity, and A/D conversion rate. Performing the A/D conversion at RF rather than IF can provide a solution to these limitations as well as a significant increase in radar sensitivity. Technology development for photonic A/D converters could lead to a new generation of receivers with superior linear dynamic range and sensitivity to counter the future TBM threat. This paper presents a novel approach to A/D conversion based upon precise optical sampling and optical phase discrimination, with the proposed development of a low jitter mode-locked laser (based quantizers with greater than 14 bit linearity (at 6 gigasamples per second). Initial measurements will be presented for UHF and S-band architectures supporting the extension of A/D converter performance well beyond the commercial regime. Converters based on this technology would enable a new class of digital receivers with about 12 dB improvement in signal-to-noise ratio, a 90 dB spurious-free dynamic range, and a 100-fold improvement in instantaneous bandwidth over conventional receiver approaches.

DTIC

*Radar Tracking; Analog to Digital Converters; Dynamic Range; Target Recognition; Missile Defense*

## 36

### LASERS AND MASERS

*Includes parametric amplifiers. For related information see also 76 Solid-State Physics.*

**19990008487** NASA Langley Research Center, Hampton, VA USA

**Method and Apparatus for Linewidth Reduction in Distributed Feedback or Distributed Bragg Reflector Semiconductor Lasers using Vertical Emission**

Cook, Anthony L., Inventor, NASA Langley Research Center, USA; Hendricks, Herbert D., Inventor, NASA Langley Research Center, USA; Oct. 27, 1998; 18p; In English

Patent Info.: Filed 26 Oct. 1995; NASA-Case-LAR-15258-1; US-Patent-5,828,688; US-Patent-Appl-SN-549347; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The linewidth of a distributed feedback semiconductor laser or a distributed Bragg reflector laser having one or more second order gratings is reduced by using an external cavity to couple the vertical emission back into the laser. This method and device prevent disturbance of the main laser beam, provide unobstructed access to laser emission for the formation of the external cavity, and do not require a very narrow heat sink. Any distributed Bragg reflector semiconductor laser or distributed feedback semiconductor laser that can produce a vertical emission through the epitaxial material and through a window in the top metallization can be used. The external cavity can be formed with an optical fiber or with a lens and a mirror of grating.

Official Gazette of the U.S. Patent and Trademark Office

*Semiconductor Lasers; Distributed Feedback Lasers; DBR Lasers; Emission; Spectral Line Width; Bragg Gratings*

**19990008640** Range Commanders Council, White Sands Missile Range, NM USA

**Laser Range Safety**

Oct. 1998; 164p; In English; Supersedes , AD-A243606.

Report No.(s): AD-A355114; RCC-316-98; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This handbook provides uniform evaluation guidance for the safe use of military lasers and laser systems on worldwide Range Commanders Council (RCC) military reservations or military controlled areas. Each military service has previously established

normal procedures for approving laser ranges. This guidance is intended to supplement these procedures. It does not replace those procedures or release individuals from compliance with the requirements of their particular service.

DTIC

*Lasers; Safety; Handbooks; Range Safety; Evaluation; Laser Damage*

**19990008937** Cornell Univ., School of Electrical Engineering, Ithaca, NY USA

**JSEP Fellowship Final Report, 1 Sep. 1996 - 30 Sep. 1998**

Krusius, Peter, Cornell Univ., USA; Sep. 30, 1998; 5p; In English

Contract(s)/Grant(s): F49620-96-1-0273

Report No.(s): AD-A354839; AFRL-SR-BL-TR-98-0666; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Dr. Mozdy produced many quality publications in his two years as a JSEP Fellow. He made significant advances in the experimental observation of chaotic systems, he interacted with colleagues at Rome Labs and at Phillips Labs, and he has subsequently gone to work for a leading US manufacturer of optical components. Eric Mozdy completed his graduate studies in May, 1998. He defended his thesis, "Chaos in the additive-pulse mode-locked laser" and accepted a position at Corning, Inc., Corning, New York as a Research Scientist in fiber optic devices starting in June, 1998. Dr. Mozdy's research advanced the experimental knowledge of chaotic lasers. Previous to his becoming a JSEP Fellow, he developed a rigorous model of a Chaotic laser which he used to simulate various dynamics of an additive-pulsed Mode-locked laser. This was described in his Master's thesis and was published in Discrete Dynamics in Nature and Society 1. His PhD work involved experimental verification of his model, and exploration of the chaotic operation of a mode-locked laser. In his work he observed the first Experimental bifurcation plot of the additive-pulse mode-locked system. In his simulations he found that the non-linearity introduced by the optical fiber in the additive-pulse mode-locked laser had a strong effect on the chaotic orbit of the pulse-to-pulse laser operation. By adjusting the coupling strength to the fiber, it was possible to drive the laser from one chaotic orbit to the next. Scanning the fiber coupling allowed Eric to observe a significant portion of the bifurcation diagram for the system.

DTIC

*Fiber Optics; Scientists; Optical Equipment; Optical Fibers; Pulsed Lasers*

## 37

### MECHANICAL ENGINEERING

*Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.*

**19990008489** NASA Ames Research Center, Moffett Field, CA USA

**Three Degree of Freedom Parallel Mechanical Linkage**

Adelstein, Bernard D., Inventor, NASA Ames Research Center, USA; Oct. 06, 1998; 16p; In English

Patent Info.: Filed 26 Jul. 1996; NASA-Case-ARC-14066-1-SB; US-Patent-5,816,105; US-Patent-Appl-SN-700584; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A three degree of freedom parallel mechanism or linkage that couples three degree of freedom translational displacements at an endpoint, such as a handle, a hand grip, or a robot tool, to link rotations about three axes that are fixed with respect to a common base or ground link. The mechanism includes a three degree of freedom spherical linkage formed of two closed loops, and a planar linkage connected to the endpoint. The closed loops are rotatably interconnected, and made of eight rigid links connected by a plurality of single degree of freedom revolute joints. Three of these revolute joints are base joints and are connected to a common ground. such that the axis lines passing through the revolute joints intersect at a common fixed center point K forming the center of a spherical work volume in which the endpoint is capable of moving. 'Me three degrees of freedom correspond to the spatial displacement of the endpoint, for instance. The mechanism provides a new overall spatial kinematic linkage composed of a minimal number of rigid links and rotary joints. The mechanism has improved mechanical stiffness, and conveys mechanical power bidirectionally between the human operator and the electromechanical actuators. It does not require gears, belts. cable, screw or other types of transmission elements, and is useful in applications requiring full backdrivability. Thus, this invention can serve as the mechanical linkage for actively powered devices such as compliant robotic manipulators and force-reflecting hand controllers, and passive devices such as manual input devices for computers and other systems.

Official Gazette of the U.S. Patent and Trademark Office

*Degrees of Freedom; Linkages; Mechanical Devices*

**19990008542** NASA Langley Research Center, Hampton, VA USA

**Fracture/Severance of Materials**

Schimmel, Morry L., Inventor, NASA Langley Research Center, USA; Bement, Laurence J., Inventor, NASA Langley Research Center, USA; DuBrucq, Glenn F., Jr., Inventor, NASA Langley Research Center, USA; Klein, Edward A., Inventor, NASA Langley Research Center, USA; Jul. 14, 1998; 8p; In English

Patent Info.: Filed 4 Apr. 1995; NASA-Case-LAR-15313-1-SB; US-Patent-5,780,763; US-Patent-Appl-SN-416597; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A method for severing or weakening materials is discussed. Explosive cords are placed in grooves on the upper surface of the material to be severed or weakened. The explosive cords are initiated simultaneously to introduce explosive shock waves into the material. These shock waves progress toward the centerline between the explosive cords and the lower surface of the material. Intersecting and reflected waves produce a rarefaction zone on the centerline to fail the material in tension. A groove may also be cut in the lower surface of the material to aid in severing or weakening the material.

Official Gazette of the U.S. Patent and Trademark Office

*Fracturing; Shock Waves; Destructive Tests; Failure Analysis; Explosions; Performance Tests*

**19990008545** NASA Langley Research Center, Hampton, VA USA

**Method of Manufacturing Carbon Fiber Reinforced Carbon Composite Valves**

Rivers, H. Kevin, Inventor, NASA Langley Research Center, USA; Ransone, Philip O., Inventor, NASA Langley Research Center, USA; Northam, G. Burton, Inventor, NASA Langley Research Center, USA; Aug. 11, 1998; 12p; In English

Patent Info.: Filed 12 Mar. 1997; NASA-Case-LAR-15653-1; US-Patent-5,792,402; US-Patent-Appl-SN-815543; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A method for forming a carbon composite valve for internal combustion engines is discussed. The process includes the steps of braiding carbon fiber into a rope thereby forming a cylindrically shaped valve stem portion and continuing to braid said fiber while introducing into the braiding carbon fiber rope a carbon matrix plug having an outer surface in a net shape of a valve head thereby forming a valve head portion. The said carbon matrix plug acting as a mandrel over which said carbon fiber rope is braided, said carbon fiber rope and carbon matrix plug forming a valve head portion suitable for mating with a valve seat; cutting said braided carbon valve stem portion at one end to form a valve tip and cutting said braided carbon fiber after said valve head portion to form a valve face and thus provide a composite valve preform; and densifying said preform by embedding the braided carbon in a matrix of carbon to convert said valve stem portion to a valve stem and said valve head portion to a valve head thereby providing said composite valve.

Official Gazette of the U.S. Patent and Trademark Office

*Carbon-Carbon Composites; Valves; Manufacturing; Braided Composites*

**19990008549** NASA Langley Research Center, Hampton, VA USA

**Carbon-Carbon Turbocharger Housing Unit for Intermittent Combustion Engines**

Northam, G. Burton, Inventor, NASA Langley Research Center, USA; Ransone, Philip O., Inventor, NASA Langley Research Center, USA; Rivers, H. Kevin, Inventor, NASA Langley Research Center, USA; Sep. 22, 1998; 5p; In English; Provisional of US-Patent-Appl-SN-012940, filed 6 Mar. 1996

Patent Info.: Filed 4 Mar. 1997; NASA-Case-LAR-15496-1; US-Patent-5,810,556; US-Patent-Appl-SN-811378; US-Patent-Appl-SN-012940; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An improved, lightweight, turbine housing unit for an intermittent combustion reciprocating internal combustion engine turbocharger is prepared from a lay-up or molding of carbon-carbon composite materials in a single-piece or two-piece process. When compared to conventional steel or cast iron, the use of carbon-carbon composite materials in a turbine housing unit reduces the overall weight of the engine and reduces the heat energy loss used in the turbocharging process. This reduction in heat energy loss and weight reduction provides for more efficient engine operation.

Official Gazette of the U.S. Patent and Trademark Office

*Carbon-Carbon Composites; Superchargers; Housings*

**19990008584** NASA Langley Research Center, Hampton, VA USA

**Fire Resistant, Moisture Barrier Membrane**

St.Clair, Terry L., Inventor, NASA Langley Research Center, USA; Aug. 04, 1998; 6p; In English; Provisional application No. 60/008,765, 15 Dec. 1995

Patent Info.: Filed 9 Dec. 1996; NASA-Case-LAR-15437-1; US-Patent-5,789,025; US-Patent-Appl-SN-772052; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche



A waterproof and breathable, fire-resistant laminate is provided for use in tents, garments, shoes, and covers, especially in industrial, military and emergency situations. The laminate permits water vapor evaporation while simultaneously preventing liquid water penetration. Further, the laminate is fire-resistant and significantly reduces the danger of toxic compound production when exposed to flame or other high heat source. The laminate may be applied to a variety of substrates and is comprised of a silicone rubber and plurality of fire-resistant, inherently thermally-stable polyimide particles.

Official Gazette of the U.S. Patent and Trademark Office

*Fires; Thermal Stability; Moisture; Membranes; Waterproofing; Thermal Resistance*

**19990008592** NASA Johnson Space Center, Houston, TX USA

**Misalignment Accommodating Connector Assembly**

Stemper, Jack S., Inventor, NASA Johnson Space Center, USA; Sep. 15, 1998; 8p; In English

Patent Info.: Filed 19 Dec. 1996; NASA-Case-MS-C-52325-1; US-Patent-5,807,007; US-Patent-Appl-SN-786843; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

Misalignment accommodating connector assembly for removably connecting first and second objects which may comprise: a first connector subassembly having an arm member extending therefrom transversely through which is provided a tubular member; a second connector subassembly having a pair of spaced apart arm members each of which is provided with a transversely disposed coaxially aligned semi-cylindrical recess for receiving opposite ends of the first connector tubular member upon lateral insertion of the first connector arm member into the space between the second connector pair of arm members. An axially extendable and contractible fastener subassembly carried by the first connector tubular member is extendable to allow insertion or removal of the first connector arm member into or from the space between the second connector pair of arm members and contractible when the opposite ends of the tubular member are substantially received by the semi-cylindrical recesses of the pair of spaced apart arm members to lock the first and second connector subassemblies together.

Official Gazette of the U.S. Patent and Trademark Office

*Misalignment; Subassemblies; Connectors*

**19990008610** NASA Ames Research Center, Moffett Field, CA USA

**Inertial Pointing and Positioning System**

Yee, Robert, Inventor, NASA Ames Research Center, USA; Robbins, Fred, Inventor, NASA Ames Research Center, USA; Sep. 15, 1998; 15p; In English

Patent Info.: Filed 8 Mar. 1996; NASA-Case-ARC-14060-1LE; US-Patent-5,809,457; US-Patent-Appl-SN-614784; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An inertial pointing and control system and method for pointing to a designated target with known coordinates from a platform to provide accurate position, steering, and command information. The system continuously receives GPS signals and corrects Inertial Navigation System (INS) dead reckoning or drift errors. An INS is mounted directly on a pointing instrument rather than in a remote location on the platform for monitoring the terrestrial position and instrument attitude. and for pointing the instrument at designated celestial targets or ground based landmarks. As a result, the pointing instrument and the INS move independently in inertial space from the platform since the INS is decoupled from the platform. Another important characteristic of the present system is that selected INS measurements are combined with predefined coordinate transformation equations and control logic algorithms under computer control in order to generate inertial pointing commands to the pointing instrument. More specifically, the computer calculates the desired instrument angles (Phi, Theta, Psi), which are then compared to the Euler angles measured by the instrument-mounted INS, and forms the pointing command error angles as a result of the compared difference.

Official Gazette of the U.S. Patent and Trademark Office

*Control Systems Design; Dead Reckoning; Inertial Navigation; Sequential Control; Targets*

**19990008669** NASA Marshall Space Flight Center, Huntsville, AL USA

**Liquid Hydrogen Testing of Silicon Nitride Bearings for Use in High Speed Turbomachinery**

Moore, Lewis, NASA Marshall Space Flight Center, USA; Gibson, Howard G., NASA Marshall Space Flight Center, USA; Thom, Robert L., NASA Marshall Space Flight Center, USA; 1998; 1p; In English; Aerospace Mechanisms, May 1998, Cocoa Beach, FL, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

Hybrid ceramic rolling element bearings are being tested in liquid hydrogen at Marshall Space Flight Center. The testing will evaluate their long term durability for use at high speeds in cryogenic rocket engine turbomachinery. The use of hybrid ceramic bearings in liquid hydrogen follows successful development and flight in liquid oxygen turbopumps.

Author

*Liquid Hydrogen; Silicon Nitrides; Turbomachinery; Roller Bearings; Ceramics; Durability; Service Life*



**19990008703** Aerospace Corp., Technology Operations, El Segundo, CA USA

**A Model to Calculate Evaporative Oil Loss in Spacecraft Mechanisms**

Carre, D. J., Aerospace Corp., USA; Bertrand, P. A., Aerospace Corp., USA; Sep. 15, 1998; 24p; In English  
Contract(s)/Grant(s): F04701-93-C-0094

Report No.(s): AD-A354744; TR-96(8565)-7; SMC-TR-98-28; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Calculations of oil loss from ball bearings in space are generally limited by the oil vapor pressure data base used in the calculations. We have developed a computer model that ties oil loss behavior of linear hydrocarbons to empirical oil loss measurements. This results in more accurate determination of evaporative oil loss. Two oils are modeled. The application of the model for the oils to actual mechanisms is discussed.

DTIC

*Oils; Losses; Computerized Simulation; Evaporation*

**19990008766** NASA Marshall Space Flight Center, Huntsville, AL USA

**A Combined Experimental and Analytical Modeling Approach to Understanding Friction Stir Welding**

Nunes, Arthur C., Jr., NASA Marshall Space Flight Center, USA; Stewart, Michael B., Arkansas Univ., USA; Adams, Glynn P., Arkansas Univ., USA; Romine, Peter, Alabama A & M Univ., USA; 1998; 15p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the Friction Stir Welding (FSW) process a rotating pin tool joins the sides of a seam by stirring them together. This solid state welding process avoids problems with melting and hot-shortness presented by some difficult-to weld high-performance light alloys. The details of the plastic flow during the process are not well understood and are currently a subject of research. Two candidate models of the FSW process, the Mixed Zone (MZ) and the Single Slip Surface (S3) model are presented and their predictions compared to experimental data.

Author

*Friction Welding; Mathematical Models; Experimentation*

**19990008897** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Studies on Friction Loss of Internal Combustion Engines**

Soejima, Mitsuhiro, Kyushu Sangyo Univ., Japan; Ejima, Yoshito, Kyushu Sangyo Univ., Japan; Nakata, Yasuhiko, Technische Univ., Germany; Groth, Klaus, Technische Univ., Germany; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 13-19; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In the present study a new test method is investigated to measure the total friction loss of engines over the whole ranges of speed and load. It is based on the idea that the friction loss close to the true one of fired and braked engines can be measured by the run-out method because the temperature mainly influencing the friction loss is almost stable for the short run-out test duration. From the test results and the comparison with those measured by other conventional test methods, the following becomes evident: (1) The frictional mean effective pressure increases slightly as the revolution speed increases, but it decreases as either the load or the cooling water temperature increases; and (2) The frictional mean effective pressure measured by the present method is smaller than that measured by the run-out method, the motoring method or Willans-line method, but it is larger than the one measured by the indicated pressure diagram method.

Author

*Friction; Losses; Internal Combustion Engines*

**19990008898** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Experimental Study on Tribological Characteristics of Cam and Tappet, Report 3, Scuffing**

Soejima, Mitsuhiro, Kyushu Sangyo Univ., Japan; Ejima, Yoshito, Kyushu Sangyo Univ., Japan; Kobayashi, Motokazu, Kyushu Sangyo Univ., Japan; Nakata, Yasuhiko, Kyushu Sangyo Univ., Japan; Mamiya, Hideyuki, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 21-28; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The present report refers to the experimental study on scuffing in tribological characteristics of cam/tappet interfaces in the engine valve train continued from the first report and the second one. by using cam/tappet test apparatus to measure the change of friction coefficient with cam angle, the occurrence conditions of scuffing failure between cam and tappet are examined by the method that only the camshaft revolution speed is gradually decreased under the maximum valve spring load and the fixed lubricant temperature after the speed and the load are alternately and gradually increased, with the temperature being raised. Test results on the scuffing characteristics are summarized as follows: (1) Scuffing failure becomes liable to occur as the valve spring load increases or the cam- shaft revolution speed decreases, or the lubricant temperature increases; (2) It is appropriate to check the

occurrence condition of scuffing failure rather from the viewpoint of the oil-film thickness limit or the oil-film rupture condition than from the viewpoint of P V value for sliding surfaces; and (3) The position of interface, where the scuffing failure initially occurs, corresponds to the timing when the cam surface from shoulder 2 to flank 2 contacts with the tappet surface. and the failure is mostly caused by the oil starvation between the surfaces.

Author

*Tribology; Internal Combustion Engines; Characteristics*

**19990008899** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Control of an Inverted Pendulum by a Rotary Arm**

Fujimoto, Takashi, Kyushu Sangyo Univ., Japan; Yamanaka, Hidefumi, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 29-34; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents the stabilizing and positioning control of an inverted pendulum of which pivot is mounted at the tip of a rotary arm driven by a DD-motor. The inverted pendulum is allowed to move in the three dimensional space, though the system has only two degrees of freedom. Consequently, the equations of motion of the mechanical system are complicated in comparison with those for the well-known model with a uniaxial traverse cart. The derivation of the equations of motion and the method of measurement of the system parameters are described in detail. Control performance of the designed digital controller is discussed comparing with the experimental results and numerical simulation.

Author

*Pendulums; Controllers; Mathematical Models*

**19990008900** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**A Diagnosis Approach to the Error Factors Acting Upon Hobbing Process Based on the Measured Error Data of a Hobbed Gear**

Chiu, Hua, Kyushu Sangyo Univ., Japan; Ariura, Yasutsune, Kyushu Sangyo Univ., Japan; Umezaki, Yoji, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 35-44; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper, the authors attempt to diagnose the factors leading to the errors of a hobbed gear, from the measured error data with the addition of the observation of hobbing mark remained in flank surface. The authors' work can mainly divide to three parts: (1) The method distinguishing the errors characterized by the static error factors from the ones characterized by the other two types, i.e. the kinematic and the dynamic error factors; (2) The method separating the influence and estimating the value of one factor, which belongs in the static error factors, from the measured error data; (3) The flow chart of the diagnosis process based on (1) and (2). The diagnosis is continue and the program will go on to the next step until the end of the process, after reaching a conclusion. A number of practical results have clearly shown this approach is useful and convenient for the application in the field of gear manufacturing.

Author

*Diagnosis; Errors; Gears*

**19990008902** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Studies on Performance of Worm Gears of New Copper Alloys, Part 3, Effect of Mating Materials on Surface Durability under Roller Test**

Iwamoto, Yoshizo, Kyushu Sangyo Univ., Japan; Hamatani, Yasumichi, Kyushu Sangyo Univ., Japan; Kizima, Tadakazu, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 53-56; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The objectives of the present study are to develop new materials for worm wheel and to investigate the surface durability of copper alloys under the roller test which simulated the gears. The mating materials are a hardened steel and four kinds of copper alloys, that is, CHT3C, AGMA5C, FA381 and PBC3C. The order of the limited surface durability obtained from experimental results for the present materials is as follows. CHT3C>AGMA5C>FA381>PBC3C, CHT3C: Special high strength Brass Casting (new materials), AGMA5C: Bronze Castings, FA381: Special Aluminium Bronze Castings, PBC3C: Phosphor Bronze Castings

Author

*Gears; Copper Alloys; Metal Surfaces; Durability*

**19990009042** Toledo Univ., Dept. of Mechanical, Industrial and Manufacturing Engineering, OH USA

**Experimental Evaluation of Journal Bearing Stability and New Gas Wave Bearing Materials** *Final Report, 18 Mar. 1997 - 31 Jan. 1998*

Keith, Theo G., Jr., Toledo Univ., USA; Dimofte, Florin, Toledo Univ., USA; Dec. 1998; 12p; In English

Contract(s)/Grant(s): NCC3-553; NCC3-388; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A gas journal bearing, with a wavy surfaces was tested in a range of speeds up to 18,000 RPM to determine its stability in an unloaded condition as a function of the wave amplitude. The bearing, was 50 mm in diameter, 58 mm long and had 0.01 65 mm radial clearance. Three waves were created on the inner surface by deforming the bearing sleeve. The ratio of the wave amplitude to the radial clearance (the wave amplitude ratio) was varied from zero to 0.3.

Author

*Journal Bearings; Gas Bearings; Amplitude Modulation; Amplitudes*

**19990009051** Toledo Univ., Dept. of Mechanical, Industrial and Manufacturing Engineering, OH USA

**Magnetic Fluid Friction and Wear Behavior** *Final Report, 18 Apr. - 17 Nov. 1997*

Keith, Theo G., Jr., Toledo Univ., USA; Dec. 1998; 8p; In English

Contract(s)/Grant(s): NCC3-558; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The friction and wear properties of two groups of magnetic fluids, one developed at NASA Lewis Research Center and a commercial fluid, were evaluated for boundary lubrication. Friction and wear measurements were made using a pin-on-disk apparatus. Three different ball materials were evaluated, (1) 440C, (2) Al<sub>2</sub>O<sub>3</sub>, and (3) Si<sub>3</sub>N<sub>4</sub> against 440C disks. The first class of magnetic fluids have a low vapor pressure hydrocarbon base oil and are suitable for space application. Four variations of this fluid were evaluated: (1) the base oil, (2) base oil with anti-wear additives, (3) a 100 Gauss strength magnetic fluid, and (4) a 400 gauss magnetic fluid. The commercial fluid base oil and four different magnetic particle concentration levels have been evaluated. A space qualified fluorinated lubricant was tested for base line comparison. Hardness, optical microscopy, surface profilometry, and surface analysis were used to characterize the test specimens. Friction was unaffected by the concentration of magnetic particles. Wear rates for magnetic fluids were slightly higher than the base oil. The low vapor pressure magnetic fluid has better wear characteristics than the space qualified fluorinated lubricant.

Author

*Abrasion Resistance; Boundary Lubrication; Ferrofluids; Friction Measurement; Lubricants; Oils; Silicon Nitrides; Vapor Pressure; Wear Inhibitors*

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### QUALITY ASSURANCE AND RELIABILITY

*Includes product sampling procedures and techniques; and quality control.*

**19990008912** Institut fuer Kunststoffverarbeitung, Aachen, Germany

**Guaranteeing 100 Percent Quality Through Closed Loop Process Control**

Schnerr, O., Institut fuer Kunststoffverarbeitung, Germany; Michaeli, W., Institut fuer Kunststoffverarbeitung, Germany; Nov. 1998; 6p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

A special method of guaranteeing quality has been developed at IKV which is titled "Closed-loop Quality Control". This firstly permits the prediction of Quality of injection moulded parts out of process variables and secondly uses the correlation between process conditions and the quality of the moulded part to control the process. With this systems for online quality control there is a possibility to reduce the scrap production without employees to a minimum. Environmental influences and charge deviations can be compensated. An on-line documentation of the quality of every moulding is a by-product of the controller.

Author

*Process Control (Industry); Feedback Control; Controllers; Quality Control; Computer Aided Manufacturing*

**19990008913** Technische Univ., Lab. for Materials Science, Delft, Netherlands

**Intelligent Processing in a Hot Rolling Mill for Structural Steels**

vanderWolk, P. J., Technische Univ., Netherlands; Dorrepaal, C., Technische Univ., Netherlands; Sietsma, J., Technische Univ., Netherlands; vanderZwaag, S., Technische Univ., Netherlands; Nov. 1998; 6p; In English; Also announced as 19990008907; Copyright Waived; Avail: CASI; A02, Hardcopy; A02, Microfiche

To control the properties of a steel, both its composition and the applied heat treatment are of paramount importance. During the hot rolling process the cooling process is of main importance to control the properties of a steel. The effect of the cooling

applied after hot rolling is usually described with CCT diagrams, as these describe a steel's transformation behaviour under continuous cooling conditions. The determination of a single CCT diagram is very time consuming; nevertheless it is necessary for each new steel composition, as the transformational behaviour is very sensitive to the chemical composition of a steel. Therefore in the present paper the CCT diagram has been modelled as a function of chemical composition using neural networks. To do so, a large number of CCT diagrams have been converted from a graphical format into a numerical format; these data have been used to fit a neural network model. This model reproduces the original CCT diagrams quite accurately, and is able to predict CCT diagrams for new steel compositions. Besides, in this way the effect of a single alloying element can be isolated; the effects of alloying elements on the CCT diagram as calculated with the model are in line with metallurgical knowledge. The number and accuracy of the CCT diagrams currently available is limited, which limits the validity of the model. The validity of the model can in principle be extended by using more and more accurate CCT diagrams.

Author

*Process Control (Industry); Artificial Intelligence; Computer Aided Manufacturing; Heat Treatment; Neural Nets; Chemical Composition; Alloying; Cooling; Steels*

**19990008933** Department of the Navy, Washington, DC USA

**System for Determining Size and Location of Defects in Material by use of Microwave Radiation**

Liu, John M., Inventor, Department of the Navy, USA; Feb. 12, 1997; 15p; In English

Patent Info.: Filed 12 Feb. 1997; US-Patent-Appl-SN-8798683

Report No.(s): AD-D019037; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

Microwave radiation emitted from a single antenna is focused on a targeted material from which backscattering of reflected radiation is received by the same antenna to provide signal measurement data from which detected material defects are evaluated by determination of void location and size. Antenna position and orientation is adjusted to obtain the signal measurement data from backscattering of the microwave radiation along at least two target incidence paths from the same target location, one of which is normal to said targeted surface of the material and the other oblique thereto at a scattering angle at which the backscattering signal radiation intensity is minimized.

DTIC

*Position (Location); Microwaves; Size (Dimensions)*

**19990009079** Auburn Univ., AL USA

**Binning for IC Quality: Experimental Studies on the SEMATECH Data**

Singh, Adit D., Auburn Univ., USA; Lakin, David R., II, Auburn Univ., USA; Sinha, Gaurav, Auburn Univ., USA; Nigh, Phil, International Business Machines Corp., USA; 1998; 10p; In English; Defect and Fault Tolerance in VLSI Systems, 2-4 Nov. 1998, Austin, TX, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Contract(s)/Grant(s): SEMATECH Proj. S121; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The earlier smaller bipolar study did not provide a high enough bin 0 population to directly observe test escapes and thereby estimate defect levels for the best bin. Results presented here indicate that the best bin can be reasonably expected to show a 2 - 5 factor improvement in defect levels over the average for the lot for moderate to high yields (the overall yield for these experiments was approximately 65%). The experiments also confirm the dependence of the best bin quality on test transparency. The defect level improvement is poorer for the case of IDDQ escapes where the tests applied had a much higher escape rate. Overall experimental results are consistent with analytical projections for typical values of the clustering parameter in [9]. The final version of this paper will include extensive analysis to validate the analytical models based on this data.

Author

*Bipolarity; Circuits; Circuit Reliability; Circuit Diagrams*

*Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.*

**19990008473** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Random Vibration of Multi-Span Mindlin Plate due to Moving Load**

Wang, Rong-Tyai, National Cheng Kung Univ., Taiwan, Province of China; Lin, Tsang-Yuan, National Cheng Kung Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 347-356; In English

Contract(s)/Grant(s): NSC85-2212-E-006-112; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper, the method of modal analysis is presented to study the random vibration of multi-span Mindlin plates due to a load moving at a constant velocity. The moving load is considered to be a stationary process with a constant mean value and a variance. Four types of variances are considered in this study: white noise, exponential, exponential cosine, and cosine. The effect of both velocity and statistical characteristics of the load, and the effect of the span number of the multi-span plate on the mean value, variance of deflection and moment of the structure are investigated. The results of the multi-span Mindlin plate are compared with those of a multi-span classical plate.

Author

*Random Vibration; Mindlin Plates; Variance (Statistics); Deflection*

**19990008474** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Effect of S/A Ratio on the Elastic Modulus of Cement-Based Materials**

Yang, Chung-Chia, National Taiwan Ocean Univ., Taiwan, Province of China; Huang, Ran, National Taiwan Ocean Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 357-364; In English

Contract(s)/Grant(s): NSC86-2211-E-019-002; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In order to the elastic modulus of aggregate and the effect of fine aggregate content on the elastic modulus of concrete, cylindrical specimens ( $\phi 100 \times 200$  mm) with different volume ratios (S/A, a fine aggregate volume/total aggregate volume) and various water/cement ratios were cast and tested. Both single-inclusion and doe-inclusion models were applied to predict the elastic moduli of two-phase and three-phase cement-based composite materials, respectively. The elastic moduli of sand and coarse aggregate were derived from the experimental results using the theoretical models. In addition, the elastic modulus of concrete is not significantly influenced by the S/A ratio for a constant aggregate volume.

Author

*Concretes; Aggregates; Cylindrical Bodies; Modulus of Elasticity; Cements*

**19990008574** NASA Lewis Research Center, Cleveland, OH USA

**Simulation of Crack Propagation in Engine Rotating Components under Variable Amplitude Loading**

Bonacuse, P. J., Army Research Lab., USA; Ghosn, L. J., Case Western Reserve Univ., USA; Telesman, J., NASA Lewis Research Center, USA; Calomino, A. M., NASA Lewis Research Center, USA; Kantzos, P., Ohio Aerospace Inst., USA; Oct. 1998; 20p; In English; Applied Vehicle Technology, 11-15 May 1998, Toulouse, France; Sponsored by Advisory Group for Aerospace Research and Development, France

Contract(s)/Grant(s): RTOP 505-23-0M; DA Proj. 1L1-61102-AH-45

Report No.(s): NASA/TM-1998-208648; E-11366; NAS 1.15:208648; ARL-MR-418; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The crack propagation life of tested specimens has been repeatedly shown to strongly depend on the loading history. Overloads and extended stress holds at temperature can either retard or accelerate the crack growth rate. Therefore, to accurately predict the crack propagation life of an actual component, it is essential to approximate the true loading history. In military rotorcraft engine applications, the loading profile (stress amplitudes, temperature, and number of excursions) can vary significantly depending on the type of mission flown. To accurately assess the durability of a fleet of engines, the crack propagation life distribution of a specific component should account for the variability in the missions performed (proportion of missions flown and sequence). In this report, analytical and experimental studies are described that calibrate/validate the crack propagation prediction capability for a disk alloy under variable amplitude loading. A crack closure based model was adopted to analytically predict the load interaction effects. Furthermore, a methodology has been developed to realistically simulate the actual mission mix loading on a fleet of engines over their lifetime. A sequence of missions is randomly selected and the number of repeats of each mission in the



sequence is determined assuming a Poisson distributed random variable with a given mean occurrence rate. Multiple realizations of random mission histories are generated in this manner and are used to produce stress, temperature, and time points for fracture mechanics calculations. The result is a cumulative distribution of crack propagation lives for a given, life limiting, component location. This information can be used to determine a safe retirement life or inspection interval for the given location.

Author

*Crack Propagation; Simulation; Rotary Wing Aircraft; Variable Amplitude Loading*

**19990008580** NASA Langley Research Center, Hampton, VA USA

**Test Fixture for Determination of Energy Absorbing Capabilities of Composite Materials**

Lavoie, J. Andre, Inventor, NASA Langley Research Center, USA; Jackson, Karen E., Inventor, NASA Langley Research Center, USA; Morton, John, Inventor, NASA Langley Research Center, USA; Sep. 22, 1998; 10p; In English; Continuation-in-part of abandoned US-Patent-Appl-SN-306556, filed 13 Sep. 1994

Patent Info.: Filed 24 Jun. 1997; NASA-Case-LAR-15212-2-CU; US-Patent-5,811,686; US-Patent-Appl-SN-881626; US-Patent-Appl-SN-306556; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention provides a fixture for supporting an elongated specimen for crush testing. The fixture comprises a base plate, four guiding rods, a sliding plate, four support rods and two collars. The guiding rods connect to the base plate and extend in a direction substantially perpendicular to the base plate. The sliding plate has linear bearings which encircle the guiding rods and enable translation of the sliding plate along the axis of each guiding rod. The four supporting rods mount to the base plate and also extend in a direction substantially perpendicular to the base plate. Each support rod has a keyway for a wedge which contacts the elongated specimen and holds the specimen in place during crushing. Each collar lies above the sliding plate and holds a pair of support rods on their ends opposite the ends connected to the base plate. A spherical bearing sits on top of the sliding plate and transfers an applied load to the sliding plate, which moves downward and crushes the elongated specimen.

Official Gazette of the U.S. Patent and Trademark Office

*Absorbers (Materials); Crushing; Inventions*

**19990008647** NASA Langley Research Center, Hampton, VA USA

**Predictive Feedback and Feedforward Control for Systems with Unknown Disturbances**

Juang, Jer-Nan, NASA Langley Research Center, USA; Eure, Kenneth W., NASA Langley Research Center, USA; Dec. 1998; 39p; In English

Contract(s)/Grant(s): RTOP 632-20-21-11

Report No.(s): NASA/TM-1998-208744; L-17788; NAS 1.15:208744; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Predictive feedback control has been successfully used in the regulation of plate vibrations when no reference signal is available for feedforward control. However, if a reference signal is available it may be used to enhance regulation by incorporating a feedforward path in the feedback controller. Such a controller is known as a hybrid controller. This paper presents the theory and implementation of the hybrid controller for general linear systems, in particular for structural vibration induced by acoustic noise. The generalized predictive control is extended to include a feedforward path in the multi-input multi-output case and implemented on a single-input single-output test plant to achieve plate vibration regulation. There are cases in acoustic-induced vibration where the disturbance signal is not available to be used by the hybrid controller, but a disturbance model is available. In this case the disturbance model may be used in the feedback controller to enhance performance. In practice, however, neither the disturbance signal nor the disturbance model is available. This paper presents the theory of identifying and incorporating the noise model into the feedback controller. Implementations are performed on a test plant and regulation improvements over the case where no noise model is used are demonstrated.

Author

*Feedback Control; Feedforward Control; Structural Vibration; Controllers; SISO (Control Systems); Control Systems Design*

**19990008895** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Investigation through Fractography of Fatigue Strength of FDI under rotating Bending or Reversed Torsion**

Teranishi, Takahiro, Kyushu Sangyo Univ., Japan; Tanaka, Satoshi, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 1-4; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Rotating bending and torsional fatigue tests were carried out on the specimens of ferritic spheroidal graphite cast iron (FDI). The initiation and propagation of microcracks were investigated through the successive observations by the plastic replica method and the observations of fracture surface by a SEM. The obtained results show that the ratio of fatigue limit  $\tau_w/\sigma_w$

w) is 0.86. The crack which leads to final fracture appears from a microshrinkage cavity. In the torsional fatigue, the microcrack can appear even when the stress is considerably lower than the fatigue limit ( $\tau = 0.65 \tau_w$ ). This is because the microshrinkage cavities adjacent to the specimen surface act as a strong stress concentrator in torsional fatigue.

Author

*Fractography; Fatigue Tests; Graphite; Bending Fatigue; Bending; Torsion; Cast Alloys*

**19990008896** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Mechanism of Ductile Fracture at Stress Concentration Area**

Sho, Kusumoto, Kyushu Sangyo Univ., Japan; Teranishi, Takahiro, Kyushu Sangyo Univ., Japan; Kubo, Akira, Kyushu Sangyo Univ., Japan; Yamamoto, Juichi, Kyushu Sangyo Univ., Japan; Tanaka, Satoshi, Kyushu Sangyo Univ., Japan; Fujisaki, Wataru, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 5-11; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Crack initiation and propagation process in tension were investigated for Ti-6Al-4V and S45C plain specimen with notches. Successive observation was made in a SEM servopulser to clarify the relationship between tensile deformation and crack initiation. The main results are summarized as follows: (1) Microcracks appear in a large deformed area in Ti-6Al-4V and in a strongly shear deformed area in S45C; (2) Net stress  $\sigma_{net}$ , in both materials is nearly equal to  $\sigma_B$  of plain specimens. This means that the most of minimum section deformed plastically under the stress nearly equal to  $\sigma_B$ ; (3) The coalescence of two notches occurred through the process of crack initiation and propagation in the strongly deformed area between the two notches in both materials; (4) With decreasing  $\rho$ , the hole deformation parameter  $hc/d$  of crack initiation increases. When  $\rho$  is constant,  $hc/d$  is almost constant, independent of the notch depth ( $\rho$ : notch radius,  $d$ : initial diameter of hole,  $h$ : height of hole,  $hc$ :  $h$  at crack initiation).

Author

*Ductility; Fracturing; Stress Concentration; Crack Propagation; Crack Initiation*

## 43

### EARTH RESOURCES AND REMOTE SENSING

*Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see 35 Instrumentation and Photography.*

**19990008463** NASA Marshall Space Flight Center, Huntsville, AL USA

**Remote Sensing Measurements of Vertical and Horizontal Moisture Variations from Aircraft Instruments**

Guillory, Anthony R., NASA Marshall Space Flight Center, USA; Jedlovec, Gary J., NASA Marshall Space Flight Center, USA; Atkinson, Robert J., Lockheed Martin Corp., USA; 10th Symposium on Meteorological Observations and Instrumentation; 1998, pp. 125-130; In English; 10th; Meteorological Observations and Instrumentation, 11-16 Jan. 1998, Phoenix, AZ, USA; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Atmospheric water plays an important role in climate processes. It is a major element of the hydrological cycle and provides the mechanism for energy exchange among many of the Earth system components. By being the principal greenhouse gas, it, along with clouds, plays a major role in the disposition of incoming and outgoing radiation. Furthermore, accurate estimates of it are required for improved analysis and prediction of convective storms. Therefore, a better understanding of water vapor's role in the hydrologic cycle will require long-term observations of both small- and large-scale water vapor features, a major goal of the National Aeronautics and Space Administration's (NASA) Mission to Planet Earth (MTPE) program. Satellite and aircraft instruments have the potential to provide high resolution measurements that are not available from conventional sources, namely the surface and radiosonde networks. An essential part of the MTPE program is field experiments that provide data for evaluating and validating algorithms and existing as well as future satellite instruments. An understanding of the accuracy of the products generated by new instruments and the limitations of their retrieval methodology is needed to further understand the usefulness of these data products. This study compares upper tropospheric humidity and precipitable water from two remote sensing instruments flown on a NASA high altitude aircraft during a field campaign in 1995. The first instrument is an infrared scanning spectrometer, while the second is a nadir viewing lidar.

Author

*Remote Sensing; Measurement; Moisture; Algorithms; Atmospheric Moisture; Optical Radar; Satellite Instruments*

**19990008710** Army Topographic Engineering Center, Alexandria, VA USA

**Map Templates for Rapid Mapping**

Nedza, John A.; Caldwell, Douglas; Jan. 1998; 11p; In English

Report No.(s): AD-A355064; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As military mapping organizations move from hardcopy map production to digital spatial data production, there is an increasing demand for end users to rapidly convert their Digital Terrain Data (DTD) to a variety of custom softcopy and hardcopy products. This paper examines the rapid mapping problem in the context of a research effort at the U.S. Topographic Engineering Center, Alexandria, VA. The Digital Chart of the World (DCW) Rapid Mapping Utility prototype GIS application demonstrates an end to end capability to efficiently process DCW data in crisis situations. Data is loaded from CD-ROM, assembled into topologically consistent layers, and processed for the production of customized maps. Using an intelligent template, a single analyst can produce softcopy or hardcopy maps of areas anywhere worldwide at scales of 1:250,000 to 1:2,000,000 in less than an hour.

DTIC

*CD-ROM; Charts; Data Processing; Digital Data; Mapping; Organizations*

**19990008725** Army Topographic Engineering Center, Fort Belvoir, VA USA

**Complementing Remote Sensing Systems in Flood Mitigation and Preparation**

Hovey, Stanford T.; Daniel, Carlton; Bryant, Paul E.; Jan. 1998; 6p; In English; Prepared in collaboration with Michael Baker, Jr., Inc.

Report No.(s): AD-A354780; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

As a result of their response to the many natural disasters of the 1990s, the Federal Emergency Management Agency (FEMA) has been directed by the U. S. Congress to place mitigation of impacts from future natural hazards as its highest priority in working with state and local governments. The National Flood Insurance Program (NFIP), and its related flood-risk studies and flood hazard mapping activities, are increasingly important mitigation support functions. A current focus is on map modernization to speed up the flood mapping process, lowering its cost, and increasing the accuracy of these results. A further emphasis is on more support to the local areas as exemplified by "Project Impact." This project's purpose is to mitigate disasters' impacts by taking actions in advance of these events.

DTIC

*Governments; Hazards; Insurance (Contracts); Mapping*

**19990008726** Army Topographic Engineering Center, Alexandria, VA USA

**The FGDC Feature Registry and its Role in Supporting Semantic Interoperability**

Backe, Kevin; Voyadgis, Demetra; Jan. 1998; 8p; In English; To be presented at the 2nd International Conference on Interoperating Geographic Information Systems, 10-12 Mar 99 in Zurich, Switzerland.

Report No.(s): AD-A354781; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper discusses the Federal Geographic Data Committee's (FGDC) Feature Registry project and what the FGDC is doing to support semantic interoperability. It also discusses the semantic information captured for geospatial data by U.S. Federal Government agencies and their current practices for semantic mapping. This paper explores current, ongoing research and development that may contribute to enhancing the semantic interoperability for the geospatial data created by the U.S. Federal Government. Finally, this paper calls for additional research on semantic mapping that hopefully will lead to simplifying what has been appropriately labeled a "hard problem."

DTIC

*Procedures; Simplification*

**19990008881** Naval Postgraduate School, Monterey, CA USA

**Map Usage in Virtual Environments**

Cevik, Helsin; Sep. 1998; 139p; In English

Report No.(s): AD-A355675; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

It is neither practical nor efficient to represent virtual maps as we do for paper maps in the real world due to major differences in hardware and software capabilities and requirements. Instead, we can determine the parameters that affect virtual map representation and that help to construct a mental map, and then manipulate these parameters in order to increase the effectiveness of map representation as an aid in performing navigation tasks. The approach taken was first to determine and then investigate the parameters that affect virtual map representation through an experiment designed specifically for this thesis. The experiment examined users of an urban and open ocean virtual environment executing a set of navigation tasks with a virtual map with different orientation schemas. The results of this study showed that, a forward up map orientation is preferable to a north up map orientation for

egocentric tasks and a north up map orientation is preferable to a forward up map orientation for geocentric tasks. Under almost every possible condition, individuals with high spatial abilities will be able to use either a north up map or a forward up map better than individuals with low spatial abilities. Furthermore, it was found that these principles apply across types of environment with vastly different spatial characteristics, but sparse environments seem to exhibit less of a performance difference than dense environments.

DTIC

*Maps; Virtual Reality; Surface Navigation; Computer Programs*

**19990008945** British Columbia Univ., Dept. of Earth and Ocean Sciences, Vancouver, British Columbia Canada

**Characterizing Scale Dependent Hydraulic Properties with Measurement of Dielectric Properties** *Final Report, 1 Feb. 1995 - 31 Jan. 1998*

Knight, Rosemary; Jul. 06, 1998; 61p; In English

Contract(s)/Grant(s): F49620-95-1-0166

Report No.(s): AD-A354605; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this research project was to develop ways to obtain information about the hydraulic properties of the subsurface from measurement of dielectric properties. The focus of the research was the use of ground penetrating radar (GPR), a high resolution geophysical technique that images changes in dielectric properties of the subsurface. Geostatistical analysis of GPR images was found to provide a non-invasive means of characterizing the spatial heterogeneity of the subsurface. Results from a field experiment, which involved the collection of GPR data across a cliff face, showed that the spatial variability seen in the GPR image was representative of the spatial variability seen in the grain size of the sediments in the cliff. Dielectric measurements can be used to obtain estimates of the magnitude of hydraulic properties, if the relationship between dielectric properties and hydraulic properties is known. Theoretical and numerical modeling, and laboratory measurements on layered materials investigated the effect of layer thickness and frequency or wavelength of the measurement. by taking these parameters into account the accuracy with which hydraulic properties are obtained from dielectric measurements can be significantly improved.

DTIC

*Dielectric Properties; Dielectrics; Geophysics; Hydrogeology*

**19990009049** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Declassified Intelligence Satellite Photography (DISP) Coverage of Antarctica**

Bindschadler, Robert, NASA Goddard Space Flight Center, USA; Seider, Wendy, Harvard Univ., USA; Nov. 1998; 44p; In English

Contract(s)/Grant(s): RTOP 971-00-00

Report No.(s): NASA/TM-1998-206879; NAS 1.15:206879; Rept-99B00001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes the results of a nine-week summer project examining all Declassified Intelligence Satellite Photography (DISP) of Antarctica. It was discovered that the data were collected in three separate missions during 1962 and 1963. The first two missions covered only the coastal areas, while the third mission covered the entire continent. Many of the 1782 frames collected were cloudy. This is especially true of West Antarctica. An optimal set of photographs covering the entire Antarctic coastline is identified along with some examples that show changes in the coastline which have occurred since the early 1960s.

Author

*Satellite-Borne Photography; Intelligence; Antarctic Regions; Satellite Imagery; Space Surveillance (Spaceborne); Reconnaissance*

## 44

### ENERGY PRODUCTION AND CONVERSION

*Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.*

**19990008583** NASA Johnson Space Center, Houston, TX USA

**High performance zinc anode for battery applications**

Casey, John E., Jr., Inventor, NASA Johnson Space Center, USA; Jul. 14, 1998; 10p; In English

Patent Info.: Filed 9 May 1996; NASA-Case-MS-C-22540-1; US-Patent-5,780,186; US-Patent-Appl-SN-649858; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An improved zinc anode for use in a high density rechargeable alkaline battery is disclosed. A process for making the zinc electrode comprises electrolytic loading of the zinc active material from a slightly acidic zinc nitrate solution into a substrate of nickel, copper or silver. The substrate comprises a sintered plaque having very fine pores, a high surface area, and 80-85 percent total initial porosity. The residual porosity after zinc loading is approximately 25-30%. The electrode of the present invention exhibits reduced zinc mobility, shape change and distortion, and demonstrates reduced dendrite buildup cycling of the battery. The disclosed battery is useful for applications requiring high energy density and multiple charge capability.

Official Gazette of the U.S. Patent and Trademark Office

*Alkaline Batteries; Electrode Materials; Nickel Zinc Batteries; Substrates; Porous Materials; Zinc; Anodes; Deposition*

**19990009080** NASA Marshall Space Flight Center, Huntsville, AL USA

**Thermal Characterization of a Direct Gain Solar Thermal Engine**

Alexander, Reginald A., NASA Marshall Space Flight Center, USA; Coleman, Hugh W., Alabama Univ., USA; Sep. 1998; 19p; In English; Renewable and Advanced Energy Systems for the 21st Century, 11-15 Apr. 1999, Maui, HI, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A thermal/fluids analysis of a direct gain solar thermal upper stage engine is presented and the results are discussed. The engine has been designed and constructed at the NASA Marshall Space Flight Center for ground testing in a facility that can provide about 10 kilowatts of concentrated solar energy to the engine. The engine transfers that energy to a coolant (hydrogen) that is heated and accelerated through a nozzle to produce thrust. For the nominal design values and a hydrogen flowrate of 2 lb/hr., the results of the analysis show that the hydrogen temperature in the chamber (nozzle entrance) reaches about 3800 F after 30 minutes of heating and about 3850 F at steady-state (slightly below the desired design temperature of about 4100 F). Sensitivity analyses showed these results to be relatively insensitive to the values used for the absorber surface infrared emissivity and the convection coefficient within the cooling ducts but very sensitive to the hydrogen flowrate. Decreasing the hydrogen flowrate to 1 lb/hr. increases the hydrogen steady-state chamber temperature to about 4700 F, but also causes an undesirable decrease in thrust.

Author

*Thermal Analysis; Solar Energy; Flow Velocity; Ground Tests*

## 45

### ENVIRONMENT POLLUTION

*Includes atmospheric, noise, thermal, and water pollution.*

**19990008482** General Motors Proving Ground, Milford, MI USA

**Diurnal Emissions from In-Use Vehicles Final Report**

Haskew, H. M., General Motors Proving Ground, USA; Liberty, T. F., General Motors Proving Ground, USA; Sep. 1998; 58p; In English

Contract(s)/Grant(s): CRC Proj. E-9

Report No.(s): PB99-107278; CRC-610; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

One hundred fifty-one vehicles were recruited from the I/M lane in Mesa, AZ during the summer of 1996, and their 24 hour diurnal emissions were measured in a variable temperature SHED (VT-SHED). The fleet selection included the earliest applications of evaporative emission control, and later technologies that has at least 5 years of exposure. Model years 1971 through 1991 were tested. 'Resting Losses' were estimated for the fleet using the last 6 hours of the diurnal. Analysis of the closed bottom canisters against the open bottom design indicated a 2 gram per day difference between the two designs. An I/M purge and pressure check identified the majority of the major failures, but often for the wrong reasons.

NTIS

*Diurnal Variations; Pollution Monitoring; Emission; Evaporation Rate; Heat Measurement; Air Pollution*

**19990008483** Automotive Testing Labs., Inc., Mesa, AZ USA

**Measurement of Diurnal Emissions from In-Use Vehicles Final Report**

McClement, D., Automotive Testing Labs., Inc., USA; Dueck, J. A., Automotive Testing Labs., Inc., USA; Hall, B., Automotive Testing Labs., Inc., USA; Jun. 19, 1997; 54p; In English

Contract(s)/Grant(s): CRC Proj. E-9

Report No.(s): PB99-107286; CRC-609; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A total of 151 randomly in-use vehicles were tested in Mesa, Arizona during the summer months of 1996. Each vehicle was sealed in variable temperature evaporative emissions enclosure (TY SHED) and exposed to a 24-hour during temperature cycle



from 72 to 96 to 72 F using new vehicle evaporative emission test certification procedures. Hydrocarbon emissions were measured continuously during the 24-hour period. The as-received fuel remained in the vehicle.

NTIS

*Diurnal Variations; Pollution Monitoring; Evaporation; Exhaust Emission; Air Pollution; Exhaust Gases*

**19990008705** General Motors Research Labs., Warren, MI USA

**Evaluation of the Sulfur Tolerance of "Sulfur Tolerant" Automotive Catalysts from Three Commercial Catalyst Suppliers**

Monroe, D., General Motors Research Labs., USA; Brady, M., Chrysler Corp., USA; Freel, J., Chevron Products Co., USA; Gerry, F., BP Oil Co., USA; Hepburn, J., Ford Motor Co., USA; Aug. 25, 1998; 48p; In English

Report No.(s): PB99-107161; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sulfur has previously been shown to reduce the performance of automotive catalytic converters and to cause significant increases in vehicle emissions. This research program was undertaken to determine the extent to which sulfur-tolerant automotive catalysts might exist within the supplier community. Meetings were held with the four largest global manufacturers of automotive catalysts, and sulfur-tolerant catalysts were requested from each. The request was for a sample of their most sulfur-tolerant technology as well as a catalyst with the same noble metal content, but without the sulfur-tolerant technology. Three of the four companies supplied samples, one elected not to participate. A catalyst used on a vehicle that has been certified to the California LEV emission standard was also included in the test matrix.

NTIS

*Automobiles; Catalysts; Combustion Products; Exhaust Emission*

**19990008761** National Inst. of Polar Research, Tokyo, Japan

**JARE Data Reports No. 227 (Ionosphere 59). Records of Radio Aurora at Syowa Station, Antarctica in 1995 and 1996**

Inamori, Koji, Communications Research Lab., Japan; Ohtaka, Kazuhiro, Communications Research Lab., Japan; Igarashi, Kiyoshi, Communications Research Lab., Japan; Mar. 1997; ISSN 0075-3343; 32p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents a summary of data obtained in the period from February 1995 to January 1996 with the auroral radar at Syowa Station, Antarctica. Two kinds of data are available: (a) chart records of the time variation of echo intensity; and (b) digital records of echo intensity and doppler velocity.

Author

*Antarctic Regions; Radio Auroras; Charts*

**19990008825** IT Corp., Cincinnati, OH USA

**Evaluation of the Full-Scale Base Catalyzed Decomposition Process (BCDP) Unit Located in Guam Topical Report, Jan. 1996 - Jul. 1998**

Aug. 1998; 200p; In English

Contract(s)/Grant(s): 68-C5-0039

Report No.(s): PB99-104713; EPA/600/R-98/108; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

In April 1996, IT Corporation began operating the first stage of a demonstration-scale system called the Base Catalyzed Decomposition Process (BCDP) on Guam for the US Navy. This report presents the results of a study funded by NRMRL. The purpose of the study was to obtain data which will facilitate a more thorough understanding of the BCD chemistry and the fate of soil-bound PCBs, polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) in the BCDP/APCS operating on Guam. The scope of this study entailed sampling and analyses of Guam soil (both before and after treatment) as well as sampling and analyses of the liquids, soil particles, and offgas streams from the APC during normal operation of the Guam BCDP system. The objectives of the study are as follows: (1) Determine the efficiency of the BCD first-stage rotary kiln reactor for removing PCBs, PCDDs, and PCDFs from Guam soil; (2) Concurrent with Objective 1, determine where in the Air Pollution Control System PCBs, PCDDs, and PCDFs are being removed.

NTIS

*Catalysis; Decomposition*

**19990008835** New Mexico State Univ., Dept. of Civil, Agricultural and Geological Engineering, Las Cruces, NM USA

**Remediation of Lead Contaminated Soils Using Solvent Extraction Chelation Techniques Final Report**

Price, M., New Mexico State Univ., USA; Hanson, A. T., New Mexico State Univ., USA; Rudd, B., New Mexico State Univ., USA; Pickins, D., New Mexico State Univ., USA; Krause, K., New Mexico State Univ., USA; 1998; 58p; In English

Report No.(s): PB99-110140; LA-SUB-98-8; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The work is preliminary work leading to the development of an innovative technology for treating a mixed waste problem at Los Alamos National Laboratory (LANL). The specific problem being addressed by this research is the result of research activity in the Meson Physics Facility (LAMPF). The LAMPF facility conducts high energy neutron research. Lead BB's (diameter <1mm) were replaced in container and used as shielding during experiments. This lead was stored in piles on the ground when it was not in use, and it sometimes sat for extended periods of time, perhaps as long as 20 years. The lead was mobilized overtime, and contaminated the underlying soil. The contaminated soil has been removed from the site and placed in drums for storage until a suitable treatment technology can be identified. The contents of the barrels consists of a mixture of lead contaminated soil and lead BB's. Treatment hardware based on the results of this years work, is described in the last section of this report.

NTIS

*Lead (Metal); Solvent Extraction; Contamination; Energy Technology; Soil Pollution; Chelates*

**19990008845** Geological Survey, Water Resources Div., Sacramento, CA USA

**Dissolved Organic Carbon Concentrations and Compositions, and Trihalomethane Formation Potentials in Waters from Agricultural Peat Soils, Sacramento-San Joaquin Delta, California: Implications for Drinking-Water Quality**

Fujii, Roger, Geological Survey, USA; Ranalli, Anthony J., Geological Survey, USA; Aiken, George R., Geological Survey, USA; Bergamaschi, Brian A., Geological Survey, USA; 1998; 86p; In English

Report No.(s): PB99-106197; USGS/WRI-98-4147; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Water exported from the Sacramento-San Joaquin River delta (Delta) is an important drinking-water source for more than 20 million people in California. This report elucidates some of the factors and processes controlling and affecting the concentration and quality of dissolved organic carbon released from peat soils and relates the propensity of dissolved organic carbon to form trihalomethanes to its chemical composition.

NTIS

*Carbon; Chemical Composition; Water Quality; Agriculture; Peat; Soils; Potable Water*

**19990008853** Powell and Associates Science Services, Las Vegas, NV USA

**Permeable Reactive Barrier Technologies for Contaminant Remediation Interim Report**

Powell, R. M., Powell and Associates Science Services, USA; Puls, R. W., Environmental Protection Agency, USA; Blowes, D. W., Waterloo Univ., Canada; Gillham, R. W., Waterloo Univ., Canada; Schultz, D., Du Pont de Nemours (E. I.) and Co., USA; Sep. 1998; 114p; In English

Contract(s)/Grant(s): 68-C3-0322; 68-C4-0031

Report No.(s): PB99-105702; EPA/600/R-98/125; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This document addresses the factors, that have been found to be relevant for successfully implementing PRBs for contaminant remediation. Additionally, it provides sufficient background in the science of PRB technology to allow a basic understanding of the chemical reactions proposed for the contaminant transformations that have been witnessed both in the laboratory and in field settings. It contains sections on PRB-treatable contaminants and the treatment reaction mechanisms, feasibility studies for PRB implementation, site characterization for PRBs, PRB design, PRB emplacement, monitoring for both compliance and performance, and summaries of several field installations. The appendices supplement this information with a detailed table of information available in the literature through 1997, summarizing the significant findings of PRB research and field studies (Appendix A), a further examination of the physical and chemical processes important to PRBs, such as corrosion, adsorption, and precipitation (Appendix B), and a set of scoping calculations that can be used to estimate the amount of reactive media required and facilitate choosing among the possible means of emplacing the required amount of media (Appendix C). Appendix D provides a list of acronyms and Appendix E a glossary of terms that are used within this document.

NTIS

*Reaction Kinetics; Contaminants; Permeability; Reactivity; Chemical Reactions*

**19990008854** QST Environmental, Inc., Gainesville, FL USA

**NERL PM Research Monitoring Platforms: Baltimore, Fresno, and Phoenix. Data Report, Feb. 1995 - Apr. 1998**

Zweidinger, Roy, Environmental Protection Agency, USA; Purdue, Larry, QST Environmental, Inc., USA; Fitzgerald, Kelly, QST Environmental, Inc., USA; Carmichael, Linda, QST Environmental, Inc., USA; Kellogg, Robert, ManTech Environmental Technology, Inc., USA; 1998; 54p; In English

Contract(s)/Grant(s): 68-D2-0134

Report No.(s): PB99-105660; EPA/600/R-98/138; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

EPA's National Exposure Research Laboratory, NERL, established PM research monitoring platforms in three metropolitan areas with differing PM size and composition characteristics: Phoenix, AZ (est. Feb. 1995), an arid, desert dust dominated western

US city where the PM10 mass is dominated by the coarse fraction; Baltimore, MD (est. Jan. 1997), a typical eastern city with high sulfates; and Fresno, CA (est. June 1997); characteristic of a western area with high nitrates. The primary objective of the research platforms was to collect daily, ambient air quality data to relate the chemical and/or physical properties of PM to support exposure, source apportionment, receptor modeling, and health effects studies. Daily fine and coarse particle mass and composition data, meteorology data, and data for other parameters relevant to the characterization of the size and composition of PM were collected, including: 24 hour integrated and hourly maximum mass concentrations, metals (XRF), organic and elemental carbon.

NTIS

*Particulates; Air Quality; Meteorology; Ambience; Chemical Properties; Monitors*

## 46 GEOPHYSICS

*Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see 93 Space Radiation.*

**19990008632** NASA Marshall Space Flight Center, Huntsville, AL USA

### **Ion Signatures of Reconnection**

Chandler, Michael O., NASA Marshall Space Flight Center, USA; Moore, T. E., NASA Goddard Space Flight Center, USA; Moz-  
er, F. S., California Univ., USA; Russell, C. T., California Univ., USA; 1998; 1p; In English; Toward Solar Max 2000, 9-14 Feb.  
1998, Yosemite, CA, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

Magnetic reconnection during periods of northward interplanetary magnetic field results in complex field line behavior. It has been shown that the velocity distribution of ions can be used as a diagnostic to determine the location of the reconnection site as well as the resulting field line topology. Ion observations in the high altitude (6-9Re) cusp region from Polar/TIDE reveal a mix of distinct ion populations (including cold ionospheric ions and magnetosheath ions) which can be attributed to different sources. In addition, the phase-space distributions of these ions reveal features which are attributed to reconnection and interactions with the magnetopause current layer (e.g. acceleration, counterstreaming, mixing of magnetosheath and ionospheric ions, and "D"-shaped distributions). These signatures has been used in several cases to infer the location of the reconnection site, the topology of the resulting field lines, and the location of the observation point relative to the magnetopause.

Author

*Magnetic Field Reconnection; Ions; Signatures; Interplanetary Magnetic Fields; Velocity Distribution*

**19990008702** Woods Hole Oceanographic Inst., Dept. of Geology and Geophysics, MA USA

### **Seismic Velocity, Stratigraphy and Acoustic Study of the South China Sea *Final Report***

Clift, Peter D.; Lin, Jian; Jan. 1998; 46p; In English

Contract(s)/Grant(s): N00014-97-1-0902

Report No.(s): AD-A354753; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study was performed of the seismic velocity structure of the South China Shelf from the westernmost parts of the Beibu Gulf, adjacent to the Gulf of Tonkin, south of Hainan Island and offshore southern mainland China, as far east as 118 deg east. Stacking velocities from petroleum industry multichannel seismic surveys were compiled into a database from which the depth or two way travel time to any given velocity interval could be calculated. The data was filtered to remove major decreases in velocity with depth, as these normally reflected decreasing data quality below -3 km. Data quality is typically good to 3 km, the approximate level of basement, and shows a good correlation with pre-existing seismic velocity data from sonobuoys. Seismically the shelf sediments are usually flat bedded, with generally well defined reflective character. The slope does not appear to be strongly affected by slumping, although locally such disturbances are noted. The seismic data show that the sediment thicknesses are greatest offshore the Pearl River Mouth (up to -5 km), where a large sedimentary basin is formed separated from the continental slope by an outer marginal basement high. Faulting in the basement is common and oriented coast-parallel. Later reactivation of these faults, sometimes results in their propagation to the seafloor.

DTIC

*Asia; China; Coasts; Continental Shelves; Crude Oil; Data Bases; Depth; Gulfs*

**19990008762** National Inst. of Polar Research, Tokyo, Japan

**JARE Data Reports No. 220 (Ionosphere 57). Records of Radio Aurora at Syowa Station Antarctica in 1993 and 1994**

Iwasaki, Kyoji, Communications Research Lab., Japan; Yamaguchi, Takashi, Communications Research Lab., Japan; Igarashi, Kiyoshi, Communications Research Lab., Japan; Mar. 1997; ISSN 0075-3343; 22p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents a summary of data obtained in the period of 1993 and 1994 with the auroral radar at Syowa Station, Antarctica. Two kinds of data are available: (a) chart records of the time variation of echo intensity; and (b) digital MT.

Derived from text

*Antarctic Regions; Charts; Radio Auroras*

**19990008864** Naval Facilities Engineering Service Center, Port Hueneme, CA USA

**Seismic Design Criteria for Lifelines Final Report, Oct. 1995 - Mar. 1997**

Ferritto, J. M.; Jun. 1997; 87p; In English

Report No.(s): AD-A355264; NFESC-TR-2078-SHR; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Navy has numerous bases located in seismically active regions throughout the world. Safe and effective structural design of waterfront facilities requires calculating the expected site specific ground motion and determining the response of these complex structures to the induced loading. The Navy's problem is further complicated by the presence of soft saturated marginal soils which can significantly amplify the levels of seismic shaking and liquefy as evidenced by recent earthquake damage. Lifelines are those key public works and utility systems which support the operation of a Navy base. They include electric power, gas and liquid fuels, telecommunications, transportation, port facilities, and water supply and sewers. Safe effective seismic design consists of three components - establishment of performance goals, specification of the earthquake loading, and given that loading, definition of the expected acceptable structural response limits. This document gives criteria for the seismic design of lifelines and contains supporting technical commentary.

DTIC

*Earthquakes; Design Analysis; Structural Design; Earth Movements; Ground Resonance; Military Air Facilities*

**19990008865** Naval Facilities Engineering Service Center, Port Hueneme, CA USA

**Criteria for Seismic Ground Motion for Essential Structures Final Report, Oct. 1995 - Mar. 1997**

Ferritto, J. M.; Jun. 1997; 42p; In English

Report No.(s): AD-A355265; NFESC-TR-2076-SHR; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Navy has numerous bases located in seismically active regions throughout the world. Safe and effective structural design of waterfront facilities requires calculating the expected site specific ground motion and determining the response of these complex structures to the induced loading. The Navy's problem is further complicated by the presence of soft saturated marginal soils which can significantly amplify the levels of seismic shaking and liquefy as evidenced by recent earthquake damage. NAVFAC P355.1 requires determination of a probabilistic ground motion for the design of essential structures; however, procedures were not specified to accomplish this requirement. This document presents criteria for computing the expected ground motion for various probabilities of nonexceedance.

DTIC

*Earthquakes; Structural Engineering; Military Air Facilities; Seismograms*

**19990008941** ENSCO, Inc., Springfield, VA USA

**Special Event Discrimination Analysis: The TEXAR Blind Test and Identification of the August 16, 1997 Kara Sea Event Final Report, 13 Sep. 1995 - 31 Jan. 1998**

Baumgardt, Douglas, ENSCO, Inc., USA; Mar. 31, 1998; 78p; In English

Contract(s)/Grant(s): F19628-95-C-0203; AF Proj. DENN

Report No.(s): AD-A354672; AFRL-VS-HA-TR-98-0049; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The International Monitoring System (IMS) for the Comprehensive Test Ban Treaty (CTBT) faces the serious challenge of being able to accurately and reliably identify seismic events in any region of the world. Extensive research has been performed in recent years on developing discrimination techniques which appear to classify seismic events into broad categories of source types, such as nuclear explosion, earthquake, and mine blast. This report examines in detail the problem of effectiveness of regional discrimination procedures in the application of waveform discriminants to Special Event identification and the issue of discriminant transportability.

DTIC

*Discriminant Analysis (Statistics); Waveforms*



**19990008943** Maxwell Technologies, Inc., San Diego, CA USA

**Analyses of Near-Field and Near-Regional Signals from the Black Thunder Mine Final Report, 10 Aug. 1995 - 9 Aug. 1997**

Barker, Terrance G., Maxwell Technologies, Inc., USA; McLaughlin, Keith L., Maxwell Technologies, Inc., USA; Feb. 1998; 52p; In English; This research was sponsored by the Department of Energy, Office of Non-Proliferation and National Security, Washington, DC.

Contract(s)/Grant(s): F19628-95-C-0112

Report No.(s): AD-A354660; MFD-DTR-98-15992; AFRL-VS-HA-TR-98-0033; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In this report we present analyses of seismic data recorded at the Black Thunder coal strip mine in the Powder River Basin of Wyoming. The data (collected by Stump et al, 1996) are a set of recordings at distances of a few kilometers from mining activity at that mine. Our objective was to determine whether these near-field data revealed features of quarry blasting that were unique to that source type. In our previous annual report on this research contract (Barker et al, 1997) and in Bonner et al, (1997), we described analyses of near-regional surface waves from a quarry in Texas. Their analyses used numerical simulations and predictions of the kinematic model in Barker et al, (1993) to interpret the dependence of amplitudes on azimuth in terms of quarry geometry and mass movement. Our objective in the current study was to apply these results to the recorded explosions at the Black Thunder mine. We find the following: (1) Ripple firing effectively low pass filters the signals, in agreement with previous studies. Since for the near-field signals at Black Thunder, the observed high frequency components of the signals are associated with P waves and the lower frequency signals are associated with surface waves (dominated by shear motion), ripple firing has the indirect effect of increasing the S/P ratio in the seismograms. (2) We observe no consistent differences between motions from cast blasts and coal shots, nor between cast shots in which the throw or strike of the bench is different. This is due to the dominance of ground motion due to explosions relative to that caused by mass movement, which is in turn is due to relative source coupling or propagation. Since differences in mass movement are the primary differences in the source mechanisms between coal and cast blasts, the dominance of the explosion component obscures the source mechanism.

DTIC

*Near Fields; Mines (Excavations)*

## 47

### METEOROLOGY AND CLIMATOLOGY

*Includes weather forecasting and modification.*

**19990008481** National Weather Service, Silver Spring, MD USA

**Selected Worldwide Marine Weather Broadcasts**

Sep. 1998; 130p; In English

Report No.(s): PB99-107245; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Part 1 contains details of radiotelephone, radiotelegraph, and radioteleprinter transmissions. It is arranged by regions with countries listed in alphabetical order within the regions. Listings in Part 1 consist of the station name followed by the radio call sign in parentheses, broadcast times, radio frequencies, class of emission, power, content and language. Part 2 contains details of radiofacsimile transmissions and is a reprint of the most current Worldwide Marine Radiofacsimile Broadcast Schedules. For ease of use, all stations are listed initially by WMO region and then country and location in alphabetical order.

NTIS

*Marine Meteorology; Weather Forecasting; Broadcasting; Transmission Rate (Communications)*

**19990008509** NASA Marshall Space Flight Center, Huntsville, AL USA

**Optical Detection of Lightning from Space**

Boccippio, Dennis J., NASA Marshall Space Flight Center, USA; Christian, Hugh J., NASA Marshall Space Flight Center, USA; 1998; 10p; In English; Lightning Detection, 16-18 Nov. 1998, Tuscon, AZ, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Optical sensors have been developed to detect lightning from space during both day and night. These sensors have been fielded in two existing satellite missions and may be included on a third mission in 2002. Satellite-hosted, optically-based lightning detection offers three unique capabilities: (1) the ability to reliably detect lightning over large, often remote, spatial regions, (2) the ability to sample all (IC and CG) lightning, and (3) the ability to detect lightning with uniform (i.e., not range-dependent) sensitivity or detection efficiency. These represent significant departures from conventional RF-based detection techniques, which typically have strong range dependencies (biases) or range limitations in their detection capabilities. The atmospheric electricity team



of the NASA Marshall Space Flight Center's Global Hydrology and Climate Center has implemented a three-step satellite lightning research program which includes three phases: proof-of-concept/climatology, science algorithm development, and operational application. The first instrument in the program, the Optical Transient Detector (OTD), is deployed on a low-earth orbit (LEO) satellite with near-polar inclination, yielding global coverage. The sensor has a 1300 x 1300 sq km field of view (FOV), moderate detection efficiency, moderate localization accuracy, and little data bias. The OTD is a proof-of-concept instrument and its mission is primarily a global lightning climatology. The limited spatial accuracy of this instrument makes it suboptimal for use in case studies, although significant science knowledge has been gained from the instrument as deployed.

Derived from text

*Optical Measuring Instruments; Lightning; Fabrication; Atmospheric Electricity; Detection*

**19990008757** Massachusetts Inst. of Tech., Cambridge, MA USA

**Physical Mechanisms Controlling Upper Tropospheric Water Vapor as Revealed by MLS Data from UARS** *Progress Report No. 1, 1 Dec. 1997 - 30 Nov. 1998*

Newell, Reginald E., Massachusetts Inst. of Tech., USA; Nov. 30, 1998; 44p; In English

Contract(s)/Grant(s): NAG5-6710; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The seasonal changes of the upper tropospheric humidity are studied with the water vapor data from the Microwave Limb Sounder on the NASA Upper Atmosphere Research Satellite, and the winds and vertical velocity data obtained from the European Centre for Medium-Range Weather Forecasts. Using the same algorithm for vertical transport as that used for horizontal transport (Zhu and Newell, 1998), we find that the moisture in the tropical upper troposphere may be increased mainly by intensified local convection in a small portion, less than 10%, of the whole area between 40 deg S to 40 deg N. The contribution of large scale background circulations and divergence of horizontal transport is relatively small in these regions. These dynamic processes cannot be revealed by the traditional analyses of moisture fluxes. The negative feedback suggested by Lindzen (1990) also exists, if enhanced convection is concentrated in the tropics, but is apparently not the dominant process in the moisture budget.

Author

*Upper Atmosphere Research Satellite (UARS); Troposphere; Water Vapor; Weather Forecasting; Annual Variations*

**19990008875** Geological Survey, Water Resources Div., Austin, TX USA

**Extreme Precipitation Depths for Texas, Excluding the Trans-Pecos Region**

Lanning-Rush, Jennifer, Geological Survey, USA; Asquith, William H., Geological Survey, USA; Slade, Raymond M., Jr., Geological Survey, USA; 1998; 48p; In English

Report No.(s): PB99-106205; USGS/WRI-98-4099; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this report is to present the extreme precipitation depths for Texas, excluding the Trans-Pecos region. Storm durations of 1,2,3,4,5, and 6 days were investigated, although the extreme precipitation depths for all of these durations are not available for each region. The extreme precipitation (EP) curves were developed from data for 24 'extreme' storms selected from a data base of 'notable' storms in Texas compiled for the study. The 24 extreme storms are identified along with 189 other notable storms in Texas (table 1 at end of report). The description and dates of occurrence for each identified storm are listed in the table. The temporal distribution of the notable and extreme storms by decade or period of occurrence is documented (table 2 at end of report).

NTIS

*Depth; Precipitation (Meteorology)*

**19990009071** Army Research Lab., White Sands Missile Range, NM USA

**Battlescale Forecast Model (BFM) Target Area Wind Speed Validation Over WSMR, NM: Initial Results** *Final Report*

Knapp, David I.; Oct. 1998; 23p; In English

Report No.(s): AD-A355826; ARL-TR-1730; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Battlescale Forecast Model (BFM) was run on a 200 MHz Pentium PC using initialization and verification data collected during November and December 1974 at WSMR, NM. BFM target area artillery wind speed forecasts were verified at two locations on the northern pan of the range. For these cases, the BFM was initialized using data from up to seven southern range locations. Gridded BFM output at the two targets was convened to standard artillery computer meteorological messages consisting of ten levels of wind data from the surface to 4 km above ground level. Output from these BFM messages was compared against similar messages derived from balloon launches at the targets and treated as truth. Additionally, BFM output was compared against messages produced by the Default Met and Time Space Weighted model techniques for the same cases. Statistical validation

calculations show that the BFM performed 75 percent better than the Default Met technique and 21 percent better than the Time Space Weighted model technique.

DTIC

*Artillery; Wind Measurement; Wind Velocity*

**19990009077** NASA Marshall Space Flight Center, Huntsville, AL USA

**Lightning Characteristics and Lightning Strike Peak Current Probabilities as Related to Aerospace Vehicle Operations**

Johnson, Dale L., NASA Marshall Space Flight Center, USA; Vaughan, William W., Alabama Univ., USA; 1998; 10p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A summary is presented of basic lightning characteristics/criteria for current and future NASA aerospace vehicles. The paper estimates the probability of occurrence of a 200 kA peak lightning return current, should lightning strike an aerospace vehicle in various operational phases, i.e., roll-out, on-pad, launch, reenter/land, and return-to-launch site. A literature search was conducted for previous work concerning occurrence and measurement of peak lighting currents, modeling, and estimating probabilities of launch vehicles/objects being struck by lightning. This paper presents these results.

Author

*Lightning; Launch Vehicles; Aerospace Vehicles; Probability Theory*

## 48

### OCEANOGRAPHY

*Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also 43 Earth Resources and Remote Sensing.*

**19990008844** Alaska Univ., Coastal Marine Inst., Fairbanks, AK USA

**Interaction between Marine Humic Matter and Polycyclic Aromatic Hydrocarbons in Lower Cook Inlet and Port Valdez, Alaska Final Report**

Shaw, David G., Alaska Univ., USA; Terschak, John, Alaska Univ., USA; Sep. 07, 1998; 44p; In English  
Report No.(s): PB99-106288; OCS/MMS-98-0033; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Humic acid is a major component of naturally occurring organic matter; it interacts strongly with organic pollutants including polycyclic aromatic hydrocarbons (PAH), a class of organic pollutants present in petroleum and associated with significant long-term environmental and human health problems. The chemical associations resulting from the interaction between humic acid and PAH influence the fate and effects of PAH which are of great concern in coastal regions such as Cook Inlet, Alaska, where petroleum production and transportation coexist with renewable resources and environmental values. This project investigated the interaction of PAH and marine humic acid from sediments of Lower Cook Inlet and Port Valdez, Alaska, in an attempt to understand how and to what extent the molecular character of humic acid from these sediments influences their ability to adsorb PAH. Geochemical characterization of sediments and humic acids from the study area showed that their chemical composition is non-uniform, probably reflecting differences in both source materials and post-depositional alterations. This result indicates that the measured concentrations of PAH are largely unrelated to the properties of the humic acid from the same sediments. It is more likely that the amounts of PAH to which the sediments are exposed control observed concentrations.

NTIS

*Polycyclic Aromatic Hydrocarbons; Cook Inlet (AK); Geochemistry; Health*

**19990008884** Arizona State Univ., Dept. of Mechanical and Aerospace Engineering, Tempe, AZ USA

**Studies on Convection in Polar Oceans Final Report, 1 Oct. 1989 - 31 Mar. 1998**

Fernando, H. J.; Jun. 30, 1998; 12p; In English

Contract(s)/Grant(s): N00014-90-J-1045

Report No.(s): AD-A355737; ASU-TR-EFD-009; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A laboratory experimental program was carried out to investigate fundamental physical processes related to deep-ocean and under-ice convection occurring in high latitude oceans. With regard to deep convection, the aspects of interest were the preconditioning of a stratified region prior to the onset of convection, breakdown of stratification leading to turbulent convection, growth of convective layer against stable stratification, scales of convection, lateral processes leading to horizontal buoyancy exchanges and the final collapse of deep-convective regions. Studies on convection under an ice cap included the formation and melting of ice due to surface cooling of a two-layer stratified fluid. This problem is rich in a variety of physical processes such as double-diffusive transports of heat and salt and turbulent mixing across the pycnocline that separates the two layers. Important new

mechanisms related to above-described convective processes were delineated and simple parameterizations were proposed to represent convective events in numerical models.

DTIC

*Turbulence; Convection; Turbulent Flow; Ice Formation; Sea Ice; Stratified Flow; Surface Cooling*

## 51

### LIFE SCIENCES (GENERAL)

**19990008604** NASA Marshall Space Flight Center, Huntsville, AL USA

#### **Media Compositions for Three-Dimensional Mammalian Tissue Growth under Microgravity Culture Conditions**

Goodwin, Thomas J., Inventor, NASA Marshall Space Flight Center, USA; Dec. 08, 1998; 14p; In English

Patent Info.: Filed 13 Feb. 1886; NASA-Case-MSC-21984-2; US-Patent-5,846,807; US-Patent-Appl-SN-600793; No Copyright;

Avail: US Patent and Trademark Office, Hardcopy, Microfiche

Normal mammalian tissue and the culturing process has been developed for the three groups of organ, structural and blood tissue. The cells are grown in vitro under microgravity culture conditions and form three dimensional cells aggregates with normal cell function. The microgravity culture conditions may be microgravity or simulated microgravity created in a horizontal rotating wall culture vessel.

Official Gazette of the U.S. Patent and Trademark Office

*Tissues (Biology); Mammals; Microgravity; Procedures*

## 52

### AEROSPACE MEDICINE

*Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.*

**19990008605** NASA Langley Research Center, Hampton, VA USA

#### **Digital Mammography with a Mosaic of CCD Arrays**

Jalink, Antony, Jr., Inventor, NASA Langley Research Center, USA; McAdoo, James A., Inventor, NASA Langley Research Center, USA; Dec. 01, 1998; 11p; In English

Patent Info.: Filed 26 Jan. 1996; NASA-Case-LAR-15059-1; US-Patent-5,844,242; US-Patent-Appl-SN-601143; No Copyright;

Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A digital mammography device uses a mosaic of electronic digital imaging arrays to scan an x-ray image is discussed. The mosaic of arrays is repositioned several times to expose different portions of the image, until the entire image is scanned. The data generated by the arrays during each exposure is stored in a computer. After the final exposure, the computer combines data of the several partial images to produce a composite of the original x-ray image. An aperture plate is used to reduce scatter and the overall exposure of the patient to x-rays.

Official Gazette of the U.S. Patent and Trademark Office

*Medical Equipment; X Ray Imagery; Imaging Techniques; Image Processing; Radiography; Biotechnology*

**19990008644** Army Research Inst. of Environmental Medicine, Natick, MA USA

#### **Effects of Exercise-Heat Stress While Wearing Five Toxic Agent Protective Systems**

Cadarette, B. S., Army Research Inst. of Environmental Medicine, USA; Levine, L., Army Research Inst. of Environmental Medicine, USA; Staab, J. E., Army Research Inst. of Environmental Medicine, USA; Kolka, M. A., Army Research Inst. of Environmental Medicine, USA; Sawka, M. N., Army Research Inst. of Environmental Medicine, USA; Apr. 1998; 73p; In English

Report No.(s): AD-A355167; USARIEM-T98-19; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This study evaluated heat strain in four developmental toxic agent protective systems relative to the standard Toxic Agent Protective (TAP) suit during exercise-heat stress. Eight subjects (6M, 2F) completed five experiments in a 38 deg C, 30% rh climate, wearing: (1) Self Contained Toxic Agent Protective Outfit (STEPO) with rebreather (STEPO-R); (2) STEPO with tether (STEPO-T); (3) Improved Toxicological Agent Protective (ITAP) suit with Self-Contained Breathing Apparatus (ITAP-SCBA); (4) ITAP with blower (ITAP-B); and (5) TAP. Experiments were treadmill walking at 0.89 m.sec<sup>-1</sup>, 0% grade, exercise/rest cycles of 20/10 min, for 240 min in STEPO and 120 min in ITAP. Mean metabolic rates were: (1) STEPO-R, 298+/-26 W; (2) STEPO-T, 299+/-34 W; (3) ITAP-SCBA, 275+/-26 W; (4) ITAP-B, 255+/-27 W; and (5) TAP, 222+/-40 W. In STEPO, subjects received whole body cooling at: STEPO-R, 200+/-36 W; and STEPO-T, 186+/-59 W. In ITAP, subjects received shirt only cooling at: ITAP-

SCBA 172+34 W; and ITAP-B, 178+/-41 W. TAP had no cooling. Comparisons were not made between STEPO and ITAP systems. Exposure time was longer (p (83+/-22 min) and STEPO-T (106+/-39 min) than in TAP (46+/-10 min). Exposure time was longer (p BA (85+/-20 min) and ITAP-B (87+/-25 min) than in TAP (46+/-10 min). Rate of heat storage (S) was less (p (37+/-8 W.m-2) and STEPO-T (38+/-12 W.m-2) than in TAP (77+/-15 W.m-2). S was less (p SCBA (51+/-16 W.m-2) than in TAP (77+/-15 W.m-2). Microclimate cooling significantly reduced S in three of four systems and increased exposure time in all four systems relative to TAP.

DTIC

*Toxicity; Breathing Apparatus; Evaluation; Protection; Physical Exercise; Heat Tolerance; Temperature Effects*

**19990008872** NASA Langley Research Center, Hampton, VA USA

**Aerospace Medicine and Biology: A Continuing Bibliography with Indexes, Supplement 481**

Dec. 28, 1998; 28p; In English

Report No.(s): NASA/SP-1998-7011/SUPPL481; NAS 1.21:7011/SUPPL481; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database.

Author

*Aerospace Medicine; Bibliographies; Data Bases*

**19990008994** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Noncontact Measurement of Internal Temperature Distribution using Ultrasonic Computed Tomography, Report 2, Numerical Simulation and Experimental Measurement**

Fujii, Motoo, Kyushu Univ., Japan; Zhang, Xing, Kyushu Univ., Japan; Kumamori, Tooru, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 131-139; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A numerical simulation and experiments are carried out for a noncontact method to measure internal temperature distribution of a solid using ultrasonic computed tomography (CT). The method is based on the fact that the sound velocity in a material depends on its temperature. 'Filtered Back Projection' is found to be the most effective algorithm for the reconstruction. To obtain an accurate temperature distribution, it is necessary to measure the sound propagation time with high resolution such as 1 ns. In the experiment, the temperature distributions are measured in a concentric cylinder with 40 mm outer diameter which is made of agar-gel and heated along center line with 0.1 mm dia. platinum wire heater. It is confirmed that the method could measure the temperature distribution inside the agar-gel within an error of 0.1 C, except for the region very close to the platinum wire.

Author

*Temperature Measurement; Ultrasonics; Tomography*

## 53

### BEHAVIORAL SCIENCES

*Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.*

**19990008502** Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia

**Psychological Approaches to Data Visualisation**

Lee, Michael D., Defence Science and Technology Organisation, Australia; Vickers, Douglas, Adelaide Univ., Australia; Jul. 1998; 53p; In English

Report No.(s): DSTO-RR-0135; DODA-AR-010-587; Copyright; Avail: Issuing Activity (DSTO Electronics and Surveillance Research Lab., PO Box 1500, Salisbury, South Australia 5108), Hardcopy, Microfiche

The aim of 'data visualisation' is to display a body of information in a way which allows accurate and effortless human comprehension and analysis. Accordingly, the development of data visualisation techniques should be constrained by an understanding of both human perception and cognition. This report develops and examines a psychological framework for the development of data visualisation techniques based on the notion of similarity structure modelling. Through a series of case studies, a range of established approaches to data visualisation is reviewed and evaluated within this framework, and a number of suggestions for the development of new techniques is made.

Author

*Psychology; Cognition; Scientific Visualization; Information Systems; Information Management*



**19990008936** Old Dominion Univ., Psychology Dept., Norfolk, VA USA

**Automation Technology and Human Performance: Current Research and Trends Final Report, 1 Jan. - 31 Aug. 1998**

Scerbo, Mark W., Editor, Old Dominion Univ., USA; Mouloua, Mustapha, Editor, University of Central Florida, USA; Jan. 1998; ISBN 0-8058-3135-5; 351p; In English; 3rd; Automation Technology and Human performance, 25-28 Mar. 1998, Norfolk, VA, USA

Contract(s)/Grant(s): N00014-98-1-0196

Report No.(s): AD-A354935; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

The implementation of complex, and "intelligent" automated devices and machines in such domains as aviation, medicine, driving, and nuclear power has brought in its wake significant new-challenges-for those who work in human factors, cognitive science, and systems engineering. Recognizing the need for a better understanding of human interaction with complex and automated systems, The Third Automation Technology and Human Performance Conference was held in Norfolk, VA, in March 1998. The purpose of this meeting was to address both basic and applied research issues regarding automation technology across a variety of domains. The present report constitutes the proceedings from that meeting and includes sections human interaction with automated technology, driving systems and driver performance, air traffic control, adaptive automation, situation awareness, monitoring and vigilance, workload and fatigue, simulation technology, design and interface issues, and several others. It is expected that innovative experimental research and design standards presented in this report will play an important role in the development of future Naval systems.

DTIC

*Automatic Control; Human Performance; Human Factors Engineering; Trends; Systems Engineering; Psychophysiology*

**19990009007** Nagoya Inst. of Tech., Japan

**The Stress-Reducing Effect of "Cooperativeness" as a Personality Trait**

Sumi, Katsunori, Nagoya Inst. of Tech., Japan; Matsunaga, Takuma, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 211-216; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this study the "stress reducing effect" of a personality trait on the stress process is investigated. A "stress-reducing effect" is composed of a "stress-buffering effect" and a "stress-suppressing effect". The former is the effect which focuses interest on the up to now, and which relieve stress as a result of a buffering of the influence of the stressor, the latter is the effect which prevents occurrence the stressor from the environment. On balance, this effect suppresses stress. A questionnaire was conducted with 155 college students as subjects. Life dissatisfaction factors as stressor were measured by five original items, and a scale of depression was used to rate-stress. In a Y-G personality inventory, the "lack of cooperativeness" scale consisted of ten items, which asserted that the personality trait measured by these items conformed exactly to "basic interpersonal trust". As a result, the hypothesized correlation of stressor or "cooperativeness" with stress, and the stress-suppressing effect of cooperativeness is demonstrated. Contrary to prediction, interaction between stressor and "cooperativeness", that is, the stress-buffering effect of "cooperativeness" was not found. Implications of the results and future research issues are discussed.

Author

*Stress Relieving; Personality; Cooperation*

**19990009018** Nagoya Inst. of Tech., Japan

**An Experimental Study on Psychological Time, Report 13, The Effects of Tasks Interposed During the Foreperiod on Reaction Time and Time Estimation**

Kohmura, Kazumi, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 11-18; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Two experiments were conducted to investigate the relation between reaction time (RT) and estimated time (ET), as continued from previous study. RT was measured by pressing a key swiftly for a light spot presented after short interval that was called foreperiod. ET was measured by the method of reproduction in remembering the duration of foreperiod used to measure RT. Correlation coefficients between RT and ET were examined in order to explore the mechanism of time estimation. Experiments were done in the unexpected situation, in which subjects were given no information about the foreperiod, and in the expectant situation, in which they were given orally information about it by experimenter. In addition to these conditions, the task was interposed in order to delay RT in present study. It was counting in the reverse order a two-or four-digit number which was given orally by experimenter. Main results were as follows: (1) RT obtained in the expectant situation was slightly shorter than that in the unexpected situation. But RT showed little difference in comparing between task conditions interposed during the foreperiod; (2) ET in both situations were longer than the foreperiod duration (standard time). and ET obtained in the expectant situation was longer than that in the unexpected situation. However, it seemed difficult to compare ET obtained in both situations each other, because sub-



jects might have used the different method of time estimation in each situation. The relative values ( $\mu$  %) of ET for each foreperiod showed little difference between the foreperiod of 12 sec and 16 sec in both situations; and (3) Correlation coefficients between RT and ET in the expectant situation were recognized to be high in comparison with those in the unexpected situation. However, it was difficult to find out the specific relation between RT and ET, because positive and negative correlation coefficients were mixed together in individual data. These findings seem to reflect that the mechanism of time estimation are very complicated because subjects try to use every possible clues obtained from the experimental situation in estimating time.

Author

*Experimentation; Reaction Time; Estimating; Tasks; Human Reactions*

## 54

### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

*Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.*

**19990009064** Defence Science and Technology Organisation, Electronics and Surveillance Lab., Salisbury, Australia

#### **Psychological Approaches to Data Visualisation**

Lee, Michael D., Defence Science and Technology Organisation, Australia; Vickers, Douglas, Adelaide Univ., Australia; Jul. 1998; 67p; In English

Report No.(s): AD-A355765; DSTO-RR-0135; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The aim of data visualization is to display a body of information in a way which allows accurate and effortless human comprehension and analysis. Accordingly, the development of data visualization techniques should be constrained by an understanding of both human perception and cognition. This report develops and examines a psychological framework for the development of data visualization techniques based on the notion of similarity structure modelling. Through a series of case studies, a range of established approaches to data visualization is reviewed and evaluated within this framework, and a number of suggestions for the development of new techniques is made.

DTIC

*Scientific Visualization; Human Factors Engineering*

## 59

### MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

**19990008479** Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

#### **Kappa-Normed Topological Vector Spaces**

Luedkovsky, S. V., Institut des Hautes Etudes Scientifiques, France; Dec. 1997; 26p; In English

Report No.(s): PB99-104812; IHES/M/97/88; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this article, Kappa-normed topological vector spaces  $X$  over the field  $K = \mathbb{R}$  or  $\mathbb{C}$  or non-Archimedean are defined and studied. It is proved that a product of Kappa-normed spaces is Kappa-normed. It is shown that in general the strict inductive limits do not preserve the property of Kappa-normability.

NTIS

*Vector Spaces; Normality; Topology*

**19990008890** NASA Ames Research Center, Moffett Field, CA USA

#### **Accelerated Training for Large Feedforward Neural Networks**

Stepniewski, Slawomir W., NASA Ames Research Center, USA; Jorgensen, Charles C., NASA Ames Research Center, USA; Nov. 1998; 14p; In English

Contract(s)/Grant(s): RTOP 519-30-12

Report No.(s): NASA/TM-1998-112239; A-9812323; NAS 1.15:112239; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper we introduce a new training algorithm, the scaled variable metric (SVM) method. Our approach attempts to increase the convergence rate of the modified variable metric method. It is also combined with the RBackprop algorithm, which computes the product of the matrix of second derivatives (Hessian) with an arbitrary vector. The RBackprop method allows us to avoid computationally expensive, direct line searches. In addition, it can be utilized in the new, 'predictive' updating technique

of the inverse Hessian approximation. We have used directional slope testing to adjust the step size and found that this strategy works exceptionally well in conjunction with the Rbackprop algorithm. Some supplementary, but nevertheless important enhancements to the basic training scheme such as improved setting of a scaling factor for the variable metric update and computationally more efficient procedure for updating the inverse Hessian approximation are presented as well. We summarize by comparing the SVM method with four first- and second- order optimization algorithms including a very effective implementation of the Levenberg-Marquardt method. Our tests indicate promising computational speed gains of the new training technique, particularly for large feedforward networks, i.e., for problems where the training process may be the most laborious.

Author

*Neural Nets; Matrices (Mathematics); Feedforward Control*

## 60

### COMPUTER OPERATIONS AND HARDWARE

*Includes hardware for computer graphics, firmware, and data processing. For components see 33 Electronics and Electrical Engineering.*

**19990008467** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

#### **Exploring the Design Space of Cache Memories, Bus Width, and Burst Transfer Memory Systems**

Chen, Chung-Ho, National Yun-Lin Univ. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 269-282; In English

Contract(s)/Grant(s): NSC85-2213-E-224-021; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Caches, data path, and burst transfer memory are the major hardware techniques used to reduce the latency between the processor and the main memory. We explore the design space among the hit ratio (hence a cache size, or an improved cache structure), data path width, and the transfer memory design through a performance tradeoff methodology. For the tradeoffs among these three factors, our evaluation shows that if a D-byte data path system and a 2D-byte data path system have the same performance, then the hit ratio difference that trades the performance of a D-byte wide data path is between 0 (low bound) and I-HR (high bound) where HR is the hit ratio associated with the D-byte system. For current main memory systems, doubling the data path trades about half of the high bound of the hit ratio traded in a transfer-time dominated system. Doubling the data bus is more advantageous when the processor is designed with the use of a high-speed non-constant-time-dominated L2 cache. Doubling the bus width trades a large percentage of the hit ratio when a large amount of non-cacheable 2D-byte memory traffic exists.

Author

*Channels (Data Transmission); Memory (Computers); Data Systems; High Speed*

**19990008585** NASA Pasadena Office, CA USA

#### **Synchronous Parallel Emulation and Discrete Event Simulation System with Self-Contained Simulation Objects and Active Event Objects**

Steinman, Jeffrey S., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Aug. 11, 1998; 32p; In English; Continuation-in-part of abandoned US-Patent-Appl-SN-246372, filed 13 Mar. 1994, which is a continuation-in-part of abandoned US-Patent-Appl-SN-880211, filed 21 Jan. 1992

Patent Info.: Filed 12 Dec. 1994; NASA-Case-NPO-18414-3-CU; US-Patent-Appl-SN-363546; US-Patent-Appl-SN-246372; US-Patent-5,794,005; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention is embodied in a method of performing object-oriented simulation and a system having inter-connected processor nodes operating in parallel to simulate mutual interactions of a set of discrete simulation objects distributed among the nodes as a sequence of discrete events changing state variables of respective simulation objects so as to generate new event-defining messages addressed to respective ones of the nodes. The object-oriented simulation is performed at each one of the nodes by assigning passive self-contained simulation objects to each one of the nodes, responding to messages received at one node by generating corresponding active event objects having user-defined inherent capabilities and individual time stamps and corresponding to respective events affecting one of the passive self-contained simulation objects of the one node, restricting the respective passive self-contained simulation objects to only providing and receiving information from the respective active event objects, requesting information and changing variables within a passive self-contained simulation object by the active event object, and producing corresponding messages specifying events resulting therefrom by the active event objects.

Official Gazette of the U.S. Patent and Trademark Office

*Object-Oriented Programming; Computerized Simulation; Message Processing*

**19990008634** NASA Marshall Space Flight Center, Huntsville, AL USA

**Analysis of a Memory Device Failure**

Nicolas, David P., NASA Marshall Space Flight Center, USA; Devaney, John, Hi-Rel Labs., Inc., USA; Gores, Mark, Hi-Rel Labs., Inc., USA; Dicken, Howard, DM Data, Inc., USA; 1998; 1p; In English; 17th, 19-20 Feb. 1998, Orange Beach, AL, USA; Meeting sponsored by AL Imaging and Microscopy Society; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

The recent failure of a vintage memory device presented a unique challenge to failure analysts. Normally device layouts, fabrication parameters and other technical information were available to assist the analyst in the analysis. However, this device was out of production for many years and the manufacturer was no longer in business, so the information was not available. To further complicate this analysis, the package leads were all but removed making additional electrical testing difficult. Under these conditions, new and innovative methods were used to analyze the failure. The external visual exam, radiography, PIND, and leak testing were performed with nominal results. Since electrical testing was precluded by the short lead lengths, the device was delidded to expose the internal structures for microscopic examination. No failure mechanism was identified. The available electrical data suggested an ESD or low level EOS type mechanism which left no visible surface damage. Due to parallel electrical paths, electrical probing on the chip failed to locate the failure site. Two non-destructive Scanning Electron Microscopy techniques, CIVA (Charge Induced Voltage Alteration) and EBIC (Electron Beam Induced Current), and a liquid crystal decoration technique which detects localized heating were employed to aid in the analysis. CIVA and EBIC isolated two faults in the input circuitry, and the liquid crystal technique further localized two hot spots in regions on two input gates. Removal of the glassivation and metallization revealed multiple failure sites located in the gate oxide of two input transistors suggesting machine (testing) induced damage.

Author

*Computer Storage Devices; Memory (Computers); Failure Analysis; Radiography*

**19990008833** Department of Energy, Assistant Secretary for Human Resources and Administration, Washington, DC USA

**US Department of Energy Information Architecture: Profile of Adopted Standards**

Sep. 1997; 112p; In English

Report No.(s): PB99-105447; DOE/HR-0175; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Department has developed an information architecture and a related standards adoption and retirement process to assist users in developing strategies and plans for acquiring information technology products and services based upon open systems standards that support application software interoperability, portability, and scalability.

NTIS

*Applications Programs (Computers); Architecture (Computers); Information Systems; Computer Networks; Data Base Management Systems*

**19990008870** Naval Postgraduate School, Monterey, CA USA

**Improving the Engineering Reconnaissance Reporting Process Through the Use of Digital Imagery and Handheld Computers**

Dalziel, Roger P.; Sep. 1998; 97p; In English

Report No.(s): AD-A355608; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This thesis explores an automated solution to improve the Engineer Reconnaissance Reporting Process. It proposes a proof-of-concept to enhance and improve the digital portion of the reporting process. This thesis defines the current process identifying its capabilities, limitations, and deficiencies. It identifies a prototype suite of equipment to perform the automation. The prototype capitalizes on the inherent capabilities on the reporting process and minimizes the deficiencies. This thesis investigates emergent Commercial-off-the-Shelf components to locate those devices that satisfy the requirements and take full advantage of current technological advances. It evaluates each component against a criteria of minimum requirements and selects the most compatible device. This thesis performs an actual implementation of the prototype testing its performance against a fictional scenario. It provides a step-by-step description and graphic representation of the implementation. This thesis analyzes and summarizes the data generated during the implementation and provides recommendations. Results of this analysis suggest implementation of the prototype is feasible and that it satisfies the imagery portion of the Engineer Reconnaissance Reporting Process.

DTIC

*Digital Systems; Imagery; Digital Computers*

## COMPUTER PROGRAMMING AND SOFTWARE

*Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.*

**19990008471** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**A Tabu-Search Based Algorithm for Concave Cost Transportation Network Problems**

Yan, Shang-Yao, National Central Univ., Taiwan, Province of China; Luo, So-Cheng, National Central Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 327-335; In English Contract(s)/Grant(s): NSC87-2211-E-008-013; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This research employs the tabu search method to develop an algorithm for efficiently solving concave cost transportation network problems which are characterized as NP-hard. An initial solution method and a linear approximation approach are also developed, to evaluate the algorithm. The preliminary results show that the algorithm is potentially useful.

Author

*Algorithms; Transportation Networks; Searching*

**19990008718** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

**Scientific Visualization and User Interfaces in Composite Manufacturing Simulations Final Report, Sep. 1997 - Mar. 1998**

Shires, Dale R.; Fink, Robert S.; Mohan, Ram V.; Sep. 1998; 29p; In English

Report No.(s): AD-A354824; ARL-TR-1790; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The importance of graphical visualization and animation in manufacturing process simulations cannot be overstated. Indeed, without effective scientific visualization tools, process simulation resultant data cannot be properly interpreted and analyzed. Software and hardware can be combined to convert what used to be page after page of printed numerical results into animated, easy to see results which are quickly rendered on graphical displays. Results that used to take days of careful study to understand can now be comprehended in minutes. With this understanding in mind, we have set out to develop novel ways to both view and interface with our manufacturing process simulations. This report discusses our selection methodology for the hardware and software used for our visualization work and relates some of our experiences in constructing specialized graphical tools. Other areas of discussion include computer codes, free software tools to build interfaces, and tracking and graphical representation of simulated and actual manufacturing process data across networks.

DTIC

*Computer Programs; Computers; Data Processing; Display Devices; Graphs (Charts)*

**19990008722** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Model-Based Verification: A Technology for Dependable System Upgrade Final Report**

Gluch, David P.; Weinstock, Charles B.; Sep. 1998; 48p; In English

Contract(s)/Grant(s): F19628-95-C-0003

Report No.(s): AD-A354756; CMU/SEI-98-TR-009; ESC-TR-98-009; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is a preliminary report on the technological foundations of model-based verification for engineering software system upgrades. It describes the historical background and technical foundations for the approach and begins to provide a basis for the transition of model-based verification into practice. Critical technical and procedural issues that have been or are being addressed to ensure successful transition are examined. The report is aimed at providing technical insight and understanding for software management and engineering personnel on this emerging technology for verification of software system upgrades.

DTIC

*Program Verification (Computers); Computer Programs; Software Engineering*

**19990008724** Aerospace Corp., Computer Systems Div., El Segundo, CA USA

**Revised and Augmented SDCE Model**

Haddad, Ranwa, Aerospace Corp., USA; Mar. 01, 1998; 164p; In English

Contract(s)/Grant(s): F04701-93-C-0094

Report No.(s): AD-A354764; TR-98(8550)-1; SMC-TR-98-30; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report documents the updated Software Development Capability Evaluation (SDCE) model. SDCE model updates reflect software lessons learned between the last publication of SDCE in 1993, and the present date (1998). The updates include three new Critical Capability Areas (CCA), namely Trusted Systems, Distributed Network Systems, and Object Oriented Development.

opments, and updates to several existing CCAs, such as Reuse, Software Development Planning, and Software Configuration Management. Traceability to the 1993 version of the SDCE model is included in the report.

DTIC

*Software Engineering; Computer Programming; Computer Programs*

**19990008732** Space and Naval Warfare Systems Command, San Diego, CA USA

**Advanced Propagation Model (APM) Computer Software Configuration Item (CSCI) Documents *Final Report***

Sailors, D. R.; Barrios, A. E.; Patterson, W. L.; Hitney, H. V.; Aug. 1998; 414p; In English

Report No.(s): AD-A354969; SPAWAR-TD-3033; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche

This document describes the Advanced Propagation Mode (APM) Version 1.0 computer software configuration item (CSCI) design and provides an input software requirement overview, a CSCI design architecture overview, and a detailed design description of each CSCI component. The Advanced Propagation Model (APM) Version 1.0 computer software configuration item (CSCI) calculates range-dependent electromagnetic (EM) system propagation loss within a heterogeneous atmospheric medium over variable terrain, where the radio-frequency index of refraction is allowed to vary both vertically and horizontally, also accounting for terrain effects along the path of propagation.

DTIC

*Computer Programs; Electromagnetic Wave Transmission; Heterogeneity; Propagation Modes*

**19990008733** Carnegie-Mellon Univ., Dept. of Computer Science, Pittsburgh, PA USA

**The Fox Project: Advanced Development of Systems Software *Progress Report, 31 Jul - 30 Sep. 1998***

Sep. 1998; 5p; In English

Contract(s)/Grant(s): F19628-95-C-0050

Report No.(s): AD-A354979; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The long term objectives of the Carnegie Mellon Fox Project are to improve the design and construction of systems software and to further the development of advanced programming language technology. We use principles and techniques from the mathematical foundations of programming languages, including semantics, type theory, and logic, to design and implement systems software, including operating systems, network protocols, and distributed systems. Much of the implementation work is conducted in the Standard ML (SML) language, a modern functional programming language that provides polymorphism, first class functions, exception handling, garbage collection, a parameterized module system, static typing, and a formal semantics. This Project involves several faculty members and spans a wide range of research areas, from (1) advanced compiler development to (2) language design to (3) software system safety infrastructure.

DTIC

*Compilers; Computer Programming; Computer Systems Programs; Language Programming; Logic Design*

**19990008821** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Second Product Line Practice Workshop Report *Final Report***

Bass, Len; Chastek, Gary; Clements, Paul; Northrop, Linda; Smith, Dennis; Apr. 1998; 43p; In English

Contract(s)/Grant(s): F19628-95-C-0003

Report No.(s): AD-A354681; CMU/SEI-98-TR-015; ESC-TR-98-015; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The second Software Engineering Institute Product Line Practice Workshop was a hands-on meeting held in November 1997 to share industry practices in software product lines and to explore the technical and non-technical issues involved. This report synthesizes the workshop presentations and discussions, which identified factors involved in product line practices and analyzed issues in the areas of software engineering, technical management, and enterprise management.

DTIC

*Software Engineering; Engineering Management; Computer Programming*

**19990008822** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**People CMM(Registered trade mark)-Based Assessment Method Description, Version 1.0 *Final Report***

Hefley, William E.; Curtis, Bill; Aug. 1998; 102p; In English

Contract(s)/Grant(s): F19628-95-C-0003

Report No.(s): AD-A354685; CMU/SEI-98-TR-012; ESC-TR-98-012; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche



This document provides a high-level overview of the People Capability Maturity Model(CMM)-Based Assessment Method. It introduces the People CMM as a source of guidelines for improving the capability and readiness of an organization's workforce in the context of the IDEAL(SM) approach to process improvement. In order to measure the capability and maturity of an organization's workforce practices, an appraisal method has been developed for the People CMM. This document describes the requirements and methods for the People CMM-Based Assessment Method. This method is a diagnostic tool that supports, enables, and encourages an organization's commitment to improving its ability to attract, develop, motivate, organize, and retain the talent needed to steadily Improve their organizational capability. The method helps an organization gain insight into its workforce capability by identifying strengths and weaknesses of its current practices related to the People CMM. The method focuses on Identifying improvements that are most beneficial, given an organization's business goals and current maturity level. Brief descriptions of the method activities, roles, and responsibilities are provided. The SEI Appraiser Program is discussed, detailing the requirements for persons qualified to lead People CMM-Based Assessments.

DTIC

*Software Engineering; Teams; Assessments*

**19990008824** Research Triangle Inst., Center for Digital Systems Engineering, Research Triangle Park, NC USA

**CAD Tools for the Development and Reuse of Models of Signal Processing Software and Hardware, Volume 1 Final Report, 1 Sep. 1993 - 1 Sep. 1996**

Frank, G. A., Research Triangle Inst., USA; Clark, B. E., Research Triangle Inst., USA; Gray, F. G., Virginia Polytechnic Inst. and State Univ., USA; Armstrong, J. R., Virginia Polytechnic Inst. and State Univ., USA; Jan. 1997; 104p; In English; Prepared in cooperation with Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

Contract(s)/Grant(s): F33615-93-C-1310; AF Proj. A268

Report No.(s): AD-A355094; WL-TR-96-1142; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

As part of the Rapid Prototyping of Application Specific Signal Processors (RASSP) programming, proof of concept/prototype toolsets were developed to automate: (1) Adaptation of signal processing algorithm data flow graphs to fit different hardware architectures; and (2) Creation of high-level VHDL test benches that can be reused as a signal processor evolves.

DTIC

*Computer Aided Design; Signal Processing; Hardware Description Languages; Computer Programs; Computers*

**19990008826** NASA Marshall Space Flight Center, Huntsville, AL USA

**An Example of Concurrent Engineering**

Rowe, Sidney, NASA Marshall Space Flight Center, USA; Whitten, David, NASA Marshall Space Flight Center, USA; Cloyd, Richard, NASA Marshall Space Flight Center, USA; Coppens, Chris, NASA Marshall Space Flight Center, USA; Rodriguez, Pedro, NASA Marshall Space Flight Center, USA; 1998; 6p; In English; Defense and Civil Space Programs, 28-30 Oct. 1998, Huntsville, AL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 98-5278; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Collaborative Engineering Design and Analysis Room (CEDAR) facility allows on-the-spot design review capability for any project during all phases of development. The required disciplines assemble in this facility to work on any problems (analysis, manufacturing, inspection, etc.) associated with a particular design. A small highly focused team of specialists can meet in this room to better expedite the process of developing a solution to an engineering task within the framework of the constraints that are unique to each discipline. This facility provides the engineering tools and translators to develop a concept within the confines of the room or with remote team members that could access the team's data from other locations. The CEDAR area is envisioned as excellent for failure investigation meetings to be conducted where the computer capabilities can be utilized in conjunction with the Smart Board display to develop failure trees, brainstorm failure modes, and evaluate possible solutions.

Author

*Facilities; Assembling; Inspection; Design Analysis; Concurrent Engineering*

**19990008860** NASA Lewis Research Center, Cleveland, OH USA

**Using Computers in Fluids Engineering Education**

Benson, Thomas J., NASA Lewis Research Center, USA; Nov. 1998; 10p; In English; Summer Fluids Engineering Conference, 21-25 Jun. 1998, Washington, DC, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): RTOP 332-41-00

Report No.(s): NASA/TM-1998-208810; NAS 1.15:208810; FEDSM98-5135; E-11400; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Three approaches for using computers to improve basic fluids engineering education are presented. The use of computational fluid dynamics solutions to fundamental flow problems is discussed. The use of interactive, highly graphical software which operates on either a modern workstation or personal computer is highlighted. and finally, the development of 'textbooks' and teaching aids which are used and distributed on the World Wide Web is described. Arguments for and against this technology as applied to undergraduate education are also discussed.

Author

*Computational Fluid Dynamics; Computers; Education; Personal Computers*

**19990008867** Georgia Inst. of Tech., Atlanta, GA USA

**User Interfaces for Cooperative Remote Design** *Annual Report, 1 Feb. 1997 - 31 Jan. 1998*

Hodges, Larry; Ribarsky, William; Jan. 31, 1998; 13p; In English

Contract(s)/Grant(s): N00014-96-1-G004

Report No.(s): AD-A355588; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Our objective in this research has been to allow teams that are physically separated to do detailed design work on large-scale, 3D projects. We seek to develop new methods to facilitate cooperative remote design utilizing both high-bandwidth networking capability and virtual reality with appropriate graphical interfaces to support the collaborative effort. The specific task is to enable multiple users to stand at each of two (or more) Virtual Workbenches at remote locations and interact effectively for design generation. We have made significant progress towards this goal. to build and test our design environment we needed a large scale and complex design model. We chose the Navy Arsenal Ship. This is a multiple deck model and our biggest initial problem was to organize and segment this model so that graphical detail could be handled efficiently and so that individual 3D objects could be moved independently. We separated the model hierarchically along decks and then further along task areas (e.g., galley, mess area, engine room, communications rooms, sleeping quarters, etc.). Initially, we implemented the model using the Simple Virtual Environment (SVE), which provides extensive software support for the creation of virtual applications including handling tracking, interactive tools, virtual menus, and display of 3D objects within the virtual environment. After this initial work we switched from SVE to the SGI Performer environment. The main reasons for this is that Performer is highly optimized for running 3D interactive simulations on Reality Engines, Infinite Reality Engines, and other high-end SGI hardware, and it has recently been made more flexible with new capabilities. Its optimizations including advanced handling of graphical details and textures to sustain interactivity and use of parallelism in multiprocessor architectures. Other capabilities include the handling of over 30 model formats and integration with Multigen modeling capacities.

DTIC

*Computer Aided Design; Computer Networks; Graphical User Interface*

**19990008901** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**A Study on the Algorithm and the Accuracy of the Circular Interpolation for NC Contour Manufacturing of Involute Tooth Profiles**

Chiu, Hua, Kyushu Sangyo Univ., Japan; Yamamoto, Jyuichi, Kyushu Sangyo Univ., Japan; Hirakawa, Isao, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 45-51; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In NC manufacturing of curve contours, the circular interpolation is widely used for generating a tool path. It hasn't completely solved how to determine the parameters of circular arcs so that the obtained interpolation error is uniform and the number of circular arcs is least. In this paper, a circular interpolation algorithm for involute tooth profiles is proposed. The computation is based on the principle of the best approximation and has two features: 1) The interpolation error is uniform and continuous: (2) The number of circular arcs is least corresponding to the interpolation error. The effectiveness of the algorithm is well confirmed by end milling tests of tooth contours with a machining center. As a comparison, the interpolation accuracy of an automatic programming system, i.e. MAPLE system, for involute tooth profiles is also investigated. The problems in MAPLE system have been pointed out according to the results of numerical and cutting tests.

Author

*Algorithms; Interpolation; Contours; Manufacturing*

**19990008935** Naval Postgraduate School, Monterey, CA USA

**Facilitating Rich Acoustical Environments in Virtual Worlds**

Hoag, Kenneth J., Sr., Naval Postgraduate School, USA; Sep. 1998; 97p; In English

Report No.(s): AD-A354946; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

The visual aspect of virtual environments has advanced at a rapid pace. The audio aspect, however, has not kept pace. Current methods of building virtual models do not address the graphical and audio aspects in an integrated fashion. Furthermore, graphical programming tools have not addressed sound in a satisfactory manner. As proof of concept, a modeling tool was developed to allow a user to build both the visual and the auditory environment simultaneously. A rendering application was developed that would display and browse a graphical environment, an audio environment, or a complete graphical/audio environment. This thesis demonstrates that building both the auditory and the visual geometry simultaneously allows for rapid, easy development of both the visual and the auditory environment. Enhancements and recommendations to current software technologies and modeling languages are introduced. New models to represent audio are introduced.

DTIC

*Software Engineering; Virtual Reality*

**19990008959** NASA Marshall Space Flight Center, Huntsville, AL USA

**Telescience Resource Kit Software Lifecycle**

Griner, Carolyn S., NASA Marshall Space Flight Center, USA; Schneider, Michelle, NASA Marshall Space Flight Center, USA; 1998; 8p; In English; 49th; International Astronautical Congress, 28 Sep. - 2 Oct. 1998, Melbourne, Australia

Report No.(s): IAF-98-U.3.04; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The challenge of a global operations capability led to the Telescience Resource Kit (TReK) project, an in-house software development project of the Mission Operations Laboratory (MOL) at NASA's Marshall Space Flight Center (MSFC). The TReK system is being developed as an inexpensive comprehensive personal computer- (PC-) based ground support system that can be used by payload users from their home sites to interact with their payloads on board the International Space Station (ISS). The TReK project is currently using a combination of the spiral lifecycle model and the incremental lifecycle model. As with any software development project, there are four activities that can be very time consuming: Software design and development, project documentation, testing, and umbrella activities, such as quality assurance and configuration management. In order to produce a quality product, it is critical that each of these activities receive the appropriate amount of attention. For TReK, the challenge was to lay out a lifecycle and project plan that provides full support for these activities, is flexible, provides a way to deal with changing risks, can accommodate unknowns, and can respond to changes in the environment quickly. This paper will provide an overview of the TReK lifecycle, a description of the project's environment, and a general overview of project activities.

Author

*Communication Networks; Computer Programming; International Space Station; Personal Computers; Software Engineering*

**19990008964** Carnegie-Mellon Univ., Dept. of Computer Science, Pittsburgh, PA USA

**Software-Controlled Multithreading Using Informing Memory Operations**

Mowry, Todd C.; Ramkissoon, Sherwyn R.; Oct. 1998; 18p; In English

Report No.(s): AD-A355852; CMU-CS-98-169; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Memory latency is becoming an increasingly important performance bottleneck, especially in multiprocessors. One technique for tolerating memory latency is multithreading, whereby we switch between threads upon expensive cache misses. In contrast with previous work on multithreading, we explore a new approach that is software-controlled rather than hardware-controlled. To implement software-controlled multithreading, we use informing memory operations to quickly trap upon cache misses to a miss handler which performs the actual thread switching in software. Our experimental results demonstrate that software-controlled multithreading can result in significant performance gains on a shared-memory multiprocessor, with the majority of applications speeding up by 10% or more, and one application speeding up by 16%. In addition, we find that by selectively applying a register partitioning optimization to reduce the thread-switching overhead, we can increase the overall speedups to as much as 25%. Given the much simpler hardware support required by our scheme, and the fact that its software overheads are expected to become less and less expensive over time relative to memory latencies, software-controlled multithreading is an attractive alternative to traditional hardware-based schemes.

DTIC

*Multiprocessing (Computers); Memory (Computers)*

**19990009068** Naval Postgraduate School, Monterey, CA USA

**Software Architecture for Distributed Real-Time Embedded Systems**

Almeida, Jose Carlos Alves de; Sep. 1998; 170p; In English

Report No.(s): AD-A355809; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Real time embedded systems have particularly strict requirements on accuracy, safety and reliability. A central question in the design of such systems is how to support concurrent processing without adversely affecting the timing requirements of the

system. Concurrent processing is essential because the only way to successfully meet some tight real time constraints is to use multiple processors. This thesis focuses on the distributed scheduling problem. It proposes a distributed scheduling algorithm to allocate and schedule a set of tasks onto a collection of processors linked by a network. It further proposes a distributed software architecture for CAPS (Computer Aided Prototyping System) generated prototypes based on GLADE (GNAT Library for Ada Distributed Execution). The new distributed CAPS architecture is applied to several prototype examples. The results show that it is possible to build distributed real time embedded systems under the distributed scheduling model, where sets of tasks run independently on each processor, using GLADE.

DTIC

*Real Time Operation; Architecture (Computers); Distributed Processing; Software Engineering; Computer Aided Design; Concurrent Processing*

## 62

### COMPUTER SYSTEMS

*Includes computer networks and special application computer systems.*

**19990008484** National Cheng Kung Univ., Inst. of Information Engineering, Tainan, Taiwan, Province of China

#### **Multimedia Synchronization with User Interactions Using Interactive Extended Finite State Machines (IEFSMS)**

Huang, Chung-Ming, National Cheng Kung Univ., Taiwan, Province of China; Wang, Chian, National Cheng Kung Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; Volume 21, No. 3, pp. 233-254; In English Contract(s)/Grant(s): NSC-86-2213-E006-071; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

One of the main and required characteristics of multimedia systems is the user-interaction service. The user-interaction service is an essential requirement in some applications, e.g., Video-On-Demand (VOD) and News-On-Demand (NOD). The user-interaction service provides flexible multimedia presentations with user interactions. That is, users are allowed to have on-line adjustment of the presentation flow, e.g., skip some (boring) media units or reverse the presentation direction, to have some special features. In this paper, we propose an Interactive Extended Finite State Machine (IEFSM) model to specify synchronization issues in multimedia presentations with user interactions. By incorporating interrupt transitions and dynamic transitions in the IEFSM model, dynamic behaviors resulting from user interactions can be modeled using some TEFSMS. Using the IEFSM model, intra-medium synchronization is handled by an Actor, which is formally represented as an IEFSM; inter-media synchronization is handled by a Synchronizer, which is also formally represented as an IEFSM. The communication between IEFSMs is message-passing through some First-In-First-Out (FIFO) queues. In this way, the dynamic behaviors of user interactions, including reverse, skip, freeze-restart, and scale can be represented in IEFSM-based multimedia synchronization specifications.

Author

*Multimedia; Synchronism; On-Line Systems; Human-Computer Interface; Turing Machines*

**19990008501** Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia

#### **An Investigation into the Use of Web Publishing and Browsing in C3I Simulation**

Pope, Andrew, Defence Science and Technology Organisation, Australia; May 1998; 42p; In English

Report No.(s): DSTO-GD-0181; DODA-AR-010-549; Copyright; Avail: Issuing Activity (DSTO Electronics and Surveillance Research Lab., PO Box 1500, Salisbury, South Australia 5108), Hardcopy, Microfiche

With the advent of World Wide Web technology, and in particular web browsing, and its increasing use in Australian command support systems such as the joint Command Support Environment (JCSE), it is essential that a capability within C3I (command, control, communications and intelligence) simulations such as the Distributed Interactive C3I Effectiveness (DICE) Simulation be developed. Over a period of three months, a suite of tools for reporting on simulation data, using a web browser as the basis for the user-interface, was developed. The end product is called WEBSTAR (WEB-based Simulation Tools for Analysis and Reporting). WEBSTAR is now in use within the DICE environment. A set of criteria for evaluating web applications is suggested. Insights into the issues associated with the use of web technologies in C3I simulation have been gained from the development of WEBSTAR and additional research. This has provided valuable information for future web technology research and development in DICE.

Author

*World Wide Web; Support Systems; Command and Control; Command Guidance*



**19990008541** NASA Lewis Research Center, Cleveland, OH USA

**Oxidation-Resistant TI-AL-FE Alloy Diffusion Barrier Coatings**

Brady, Michael P., Inventor, NASA Lewis Research Center, USA; Smialek, James L., Inventor, NASA Lewis Research Center, USA; Brindley, William J., Inventor, NASA Lewis Research Center, USA; Jul. 07, 1998; 7p; In English

Patent Info.: Filed 21 Oct. 1996; NASA-Case-LEW-200006-1; US-Patent-5,776,617; US-Patent-Appl-SN-735368; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A diffusion barrier to help protect titanium aluminide alloys, including the coated alloys of the TiAl( $\gamma$ )+Ti<sub>3</sub>Al ( $\alpha$  (sub 2)) class, from oxidative attack and interstitial embrittlement at temperatures up to at least 1000 C is disclosed. The coating may comprise FeCrAlX alloys. The diffusion barrier comprises titanium, aluminum, and iron in the following approximate atomic percent: Ti-(50-55)Al-(9-20)Fe. This alloy is also suitable as an oxidative or structural coating for such substrates.

Official Gazette of the U.S. Patent and Trademark Office

*Titanium Aluminides; Protective Coatings; Aluminum Alloys; Titanium Alloys; Embrittlement; Metal Coatings; Iron*

**19990008590** NASA Pasadena Office, CA USA

**Parallel Proximity Detection for Computer Simulations**

Steinman, Jeffrey S., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Wieland, Frederick P., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Jul. 14, 1998; 18p; In English; Division of US-Patent-Appl-SN-425751, filed 10 Apr. 1995, US-Patent-5,652,871

Patent Info.: Filed 7 Mar. 1997; NASA-Case-NPO-19423-2; US-Patent-Appl-SN-813531; US-Patent-Appl-SN-425751; US-Patent-5,781,762; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

The present invention discloses a system for performing proximity detection in computer simulations on parallel processing architectures utilizing a distribution list which includes movers and sensor coverages which check in and out of grids. Each mover maintains a list of sensors that detect the mover's motion as the mover and sensor coverages check in and out of the grids. Fuzzy grids are included by fuzzy resolution parameters to allow movers and sensor coverages to check in and out of grids without computing exact grid crossings. The movers check in and out of grids while moving sensors periodically inform the grids of their coverage. In addition, a lookahead function is also included for providing a generalized capability without making any limiting assumptions about the particular application to which it is applied. The lookahead function is initiated so that risk-free synchronization strategies never roll back grid events. The lookahead function adds fixed delays as events are scheduled for objects on other nodes.

Official Gazette of the U.S. Patent and Trademark Office

*Architecture (Computers); Parallel Processing (Computers); Computerized Simulation*

**19990008611** NASA Ames Research Center, Moffett Field, CA USA

**Scalable Hierarchical Network Management System for Displaying Network Information in Three Dimensions**

George, Jude, Inventor, NASA Ames Research Center, USA; Schlecht, Leslie, Inventor, NASA Ames Research Center, USA; McCabe, James D., Inventor, NASA Ames Research Center, USA; LeKashman, John Jr., Inventor, NASA Ames Research Center, USA; Jun. 30, 1998; 71p; In English

Patent Info.: Filed 28 Jul. 1995; NASA-Case-ARC-12097-1LE; US-Patent-5,774,669; US-Patent-Appl-SN-505723; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A network management system has SNMP agents distributed at one or more sites, an input output module at each site, and a server module located at a selected site for communicating with input output modules, each of which is configured for both SNMP and HNMP communications. The server module is configured exclusively for HNMP communications, and it communicates with each input output module according to the HNMP. Non-iconified, informationally complete views are provided of network elements to aid in network management.

Official Gazette of the U.S. Patent and Trademark Office

*Management Systems; Networks*

**19990008712** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**A Case Study in Survivable Network System Analysis Final Report**

Ellison, R. J.; Linger, R. C.; Longstaff, T.; Mead, N. R.; Sep. 1998; 35p; In English

Contract(s)/Grant(s): F19628-95-C-0003

Report No.(s): AD-A355070; CMU/SEI-98-TR-014; ESC\*-TR-98-014; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche



This paper presents a method for analyzing the survivability of distributed network systems and an example of its application. Survivability is the capability of a system to fulfill its mission, in a timely manner, in the presence of attacks, failures, or accidents. Survivability requires capabilities for intrusion resistance, recognition, and recovery. The Survivable Network Analysis (SNA) method builds on the Information Security Evaluation previously developed by permitting assessment of survivability strategies at the architecture level. Steps in the SNA method include system mission and architecture definition, essential capability definition, compromisable capability definition, and survivability analysis of architectural softspots that are both essential and compromisable. Intrusion scenarios play a key role in the method. SNA results are summarized in a Survivability Map which links recommended survivability strategies for resistance, recognition, and recovery to the system architecture and requirements. This case study summarizes the application and results of applying the SNA method to a subsystem of a large scale, distributed health-care system. The study recommended specific modifications to the subsystem architecture to support survivability objectives. Positive client response to study recommendations suggests that the method can provide significant added value for ensuring survivability of system operations. As a result of this case study, the SNA method, artifacts, and lessons learned will be available to apply architectural analysis for survivability to proposed and legacy DoD distributed systems.

DTIC

*Network Analysis; Systems Analysis; Computer Networks*

**19990008720** Army Topographic Engineering Center, Alexandria, VA USA

**Simulation Database Archive and Reuse Project**

Bevan, Michelle T.; Jan. 1998; 4p; In English

Report No.(s): AD-A354826; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

One of the continuing challenges to the Modeling and Simulation (M&S) community is finding the appropriate terrain databases (TDBs) for a simulation exercise. The U.S. Army Topographic Engineering Center (TEC) has produced a number of terrain databases through contract, in-house, and cooperative efforts. Over the years these efforts have accumulated a list of TDBs that are available to the DoD M&S community. Unfortunately, many of these databases were not created with reuse in mind. This paper will summarize the efforts of the Simulation Data Archive and Reuse (SDAR) project sponsored by the Defense Modeling and Simulation Office (DMSO), managed by the Terrain Modeling Projects Office (TMPO) of the National Imagery and Mapping Agency (NIMA), and executed by TEC. The project covers the entire process from cataloging existing databases to making them available via the Master Environmental Library (MEL) in several, commonly used compilations. This paper details that process and lists the databases currently available for reuse.

DTIC

*Accumulations; Data Bases; Imagery; Libraries; Physical Exercise*

**19990008823** Information Science Inst., Marina del Rey, CA USA

**Netstation Architecture and Advanced ATOMIC Network Final Report, 1 Oct. 1993 - 31 Dec. 1997**

Finn, Gregory, Information Science Inst., USA; Touch, Joseph, Information Science Inst., USA; Oct. 12, 1998; 27p; In English  
Contract(s)/Grant(s): DABT63-93-C-0062

Report No.(s): AD-A355093; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The NAAAN project is composed of two major tasks; Netstation and Advanced Atomic Networking (the latter informally called ATOMIC-2). The Netstation task concerns itself with issues that arise when a gigabit network is substituted in workstations in place of a system bus. The ATOMIC-2 task focuses on generalizing the ATOMIC gigabit LAN technology, so that it interoperates with workstations and other networks in much the same way that Ethernet based LANs do.

DTIC

*Architecture (Computers); Atoms; Local Area Networks*

**19990008942** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

**Vulnerability Assessment of the InterNetwork Controller (INC) Final Report, 1 Oct. 1995 - 10 Dec. 1996**

Retter, Charles; Gwyn, Douglas; Sep. 1998; 33p; In English

Contract(s)/Grant(s): 622120H16

Report No.(s): AD-A354665; ARL-MR-412; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Tactical Internet (TI) provides a reliable digital communications infrastructure for Task Force XXI at brigade level and below. The InterNetwork controller (INC) performs routing and protocol conversion of data traffic within the TI, so its vulnerabilities could have significant adverse effects on the flow and content of data communications within the TI. This report summarizes

the results of a study of potential "information warfare" vulnerabilities of the INC's interfaces, configuration, protocols, procedures, and policies.

DTIC

*Vulnerability; Internets; Controllers; Digital Systems; Pulse Communication*

**19990008946** Office of the Director of Defense Research and Engineering, Washington, DC USA

**HPC Modernization Program, Modernization Plan 1998, High Performance Computing, Supporting the Warfighter**

Jan. 1998; 26p; In English; Original contains color plates

Report No.(s): AD-A354593; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

High performance computing (HPC) has historically played a major role in the ability of the USA to develop and deploy superior weapons, warfighting capabilities, and mission support systems. Under the auspices of the Director, Defense Research and Engineering (DDR&E), the Department of Defense (DoD) High Performance Computing Modernization Program (HPCMP) is the focused modernization effort within the DoD to acquire, manage, and sustain modern HPC resources in support of defense science and technology, and developmental test and evaluation. The HPCMP is rapidly evolving past its initial program development and procurement start up phase and is increasing focus on application of HPC technology and resources to priority defense requirements. This plan describes some of the accomplishments achieved by the program in Fiscal Year (FY) 1997 and outlines the major strategies and milestones we expect to achieve over the next two years. The overriding goal of the program is to exploit HPC technology for military advantage across battlespace. The strategy to achieve this goal is to acquire and sustain world class high performance computing and network capabilities for use by defense scientists and engineers.

DTIC

*Defense Program; Computer Networks*

**19990009056** Old Dominion Univ., Dept. of Computer Science, Norfolk, VA USA

**Sensitivity Analysis of Data Link Alternatives for LVLASO Final Report, 6 Jan. - 30 Sep. 1998**

Mukkamala, Ravi, Old Dominion Univ., USA; Dec. 1998; 36p; In English

Contract(s)/Grant(s): NAG1-1853

Report No.(s): ODURF-163641; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As part of this research, we have modeled the Mode-S system when used to enhance communications among several ground vehicles to facilitate low-visibility landing and surface operations. The model has then been simulated using Bones Designer software. The effectiveness of the model has been evaluated under several conditions: (i) different number of vehicles (100, 200, and 300), (ii) different distributions of interarrival times for squitters: uniform, exponential, and constrained exponential, and (iii) Different safe distances (for collision purpose): squitter length, 1.5\*squitter length, and 2\* squitter length. The model has been developed in a modular fashion to facilitate any future modifications. The results from the simulations suggest that the Mode S system is indeed capable of functioning satisfactorily even when covering up to 300 vehicles. Certainly, about 10 percent of the squitters undergo collisions and hence the interarrival times for these is much larger than the expected time of 500 msec. In fact, the delay could be as much as 2 seconds. The model could be further enhanced to incorporate more realistic scenarios.

Author

*Aircraft Landing; Landing Aids; Instrument Landing Systems; Enhanced Vision; Runway Alignment; Visibility*

**19990009063** Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia  
**An Investigation into the Use of Web Publishing and Browsing in C3I Simulation**

Pope, Andrew, Defence Science and Technology Organisation, Australia; May 1998; 43p; In English

Report No.(s): AD-A355694; DSTO-GD-0181; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the advent of World Wide Web technology, and in particular web browsing, and its increasing use in Australian command support systems such as the Joint Command Support Environment (JCSE), it is essential that a capability within C3I (command, control, communications and intelligence) simulations such as the Distributed Interactive C3I Effectiveness (DICE) Simulation be developed. Over a period of three months, a suite of tools for reporting on simulation data, using a web browser as the basis for the user interface, was developed. The end product is called WEBSTAR (WEB based Simulation Tools for Analysis and Reporting). WEBSTAR is now in use within the DICE environment. A set of criteria for evaluating web applications is suggested. Insights into the issues associated with the use of web technologies in C3I simulation have been gained from the development of WEBSTAR and additional research. This has provided valuable information for future web technology research and development in DICE.

DTIC

*Command and Control; Command Guidance; Computerized Simulation; Intelligence; Support Systems*

**19990009065** Naval Postgraduate School, Monterey, CA USA

**A Protocol for Building a Network Access Controller (NAC) for "IP over ATM"**

Kondoulis, Ioannis; Sep. 1998; 231p; In English

Report No.(s): AD-A355771; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The implementation of label swapping packet forwarding technology increases the vulnerability to insider attacks. These attacks refer to unauthorized access from within an enclave to the outside network. In this thesis we propose a protocol to counter this category of attacks. The proposed protocol provides a means for fast packet authentication. High speed is achieved by the use of a trailer, which allows packet filtering at Layer 2, and the use of cheap and fast message digest algorithms. To overcome the weaknesses of a 128 bit message digest algorithm, each key is designed to have a very short cryptoperiod. Such fast rekeying is implemented by key caching (the host has a table of keys). Initial performance measurements indicated that it is possible to use our protocol while maintaining very high data throughput. Specifically, our protocol implements an authentication module, called Network Access Controller (NAC). The NAC's modular nature allows it to be easily integrated with a variety of routing technologies and other security mechanisms while remaining totally independent of them.

DTIC

*Internets; Asynchronous Transfer Mode; Computer Information Security; Data Processing*

**19990009066** Naval Postgraduate School, Monterey, CA USA

**Design Considerations to be Addressed when Developing Web Based Applications for Senior Managers**

Hardy, David Wallace; Sep. 1998; 89p; In English

Report No.(s): AD-A355772; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This thesis develops guidelines for building Web sites that are useful to senior managers in two ways. First, these managers can obtain information from or pass information to a site in order to accomplish tasks more effectively and efficiently. Secondly, the senior manager must be able to go to a site and use that site without being required to undergo instruction or read manuals before using the site. Web technology is in place to assist these managers in performing at a higher level. Methodologies used in this thesis combine a study using sample web sites, based on the Center for Executive Education Web Site, two surveys, database connectivity, and usability design practices to aid in Internet or intranet based applications. This document contains results from surveys of senior managers that are evaluated to select a suitable methodology for designing Web sites specifically for this subset of users.

DTIC

*Internets; Data Bases; Information Transfer*

**19990009069** Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia

**Performance Characteristics of a Java Object Request Broker**

Miron, David; Taylor, Samuel; Jun. 1998; 28p; In English

Report No.(s): AD-A355819; DSTO-TR-0696; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The efficiency of the Common Object Request Broker Architecture (CORBA) for the transfer of large files over a network is of particular interest to the Imagery Management and Dissemination Group (IMAD). The IMAD group will be using Java and CORBA for such transfers. This report studies the performance of a Java Object Request Broker (ORB) for the transfer of large files over such networks. This performance analysis is done using the Visigenics ORB Visibroker and involves the measurement of throughput and latency. These measurements are then compared with the results obtained when using socket to socket connections. The results show that the throughput of an ORB for large file transfer approaches that of sockets on low bandwidth networks. However on high bandwidth networks the throughput using the ORB is significantly less than that using sockets. It is also shown that the latency incurred by the ORB is much greater than that incurred using sockets.

DTIC

*Bandwidth; Imagery*

## 63 CYBERNETICS

*Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also 54 Man/ System Technology and Life Support.*

**19990008593** NASA Johnson Space Center, Houston, TX USA

**Real-Time Reconfigurable Adaptive Speech Recognition Command and Control Apparatus and Method**

Salazar, George A., Inventor, NASA Johnson Space Center, USA; Haynes, Dena S., Inventor, NASA Johnson Space Center, USA;

Sommers, Marc J., Inventor, NASA Johnson Space Center, USA; Jun. 30, 1998; 26p; In English  
Patent Info.: Filed 20 Sep. 1995; NASA-Case-MSC-22532-1; US-Patent-5,774,841; US-Patent-Appl-SN-536302; No Copyright;  
Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An adaptive speech recognition and control system and method for controlling various mechanisms and systems in response to spoken instructions and in which spoken commands are effective to direct the system into appropriate memory nodes, and to respective appropriate memory templates corresponding to the voiced command is discussed. Spoken commands from any of a group of operators for which the system is trained may be identified, and voice templates are updated as required in response to changes in pronunciation and voice characteristics over time of any of the operators for which the system is trained. Provisions are made for both near-real-time retraining of the system with respect to individual terms which are determined not to be positively identified, and for an overall system training and updating process in which recognition of each command and vocabulary term is checked, and in which the memory templates are retrained if necessary for respective commands or vocabulary terms with respect to an operator currently using the system. In one embodiment, the system includes input circuitry connected to a microphone and including signal processing and control sections for sensing the level of vocabulary recognition over a given period and, if recognition performance falls below a given level, processing audio-derived signals for enhancing recognition performance of the system.

Official Gazette of the U.S. Patent and Trademark Office

*Speech Recognition; Command and Control; Signal Processing; Voice Control; Adaptive Control; Voice Data Processing*

**19990008728** Army Communications-Electronics Command, Fort Monmouth, NJ USA

**A Fuzzy Hypercube Artificial Neural Network Classifier**

Karakowski, Joseph A.; Phu, Hai H.; Oct. 1998; 47p; In English

Report No.(s): AD-A354805; CECOM-TR-98-4; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An Artificial Neural Network classifier, based on fuzzy Min-Max, Adaptive Resonant Theory (ART), and fuzzy ART is described. The outputs of the classifier are fuzzy hypercubes representing functional categories of its input functions. A hypothesis and test paradigm compares input data and existing hypercube categories, and results in either network resonance or dissonance, depending on the test outcome. A hypothesis is formed by two match functions: Degree of Inclusion, and Degree of Perfect Match. An overall hypothesis is chosen with the best Degree of Match. Tests are then performed to verify the hypothesis. The vigilance test measures the top down match between the hypothesized category and the input. The overall hypervolume test ensures that any category adjustments keep the total category hypercube volume within bounds. The fuzzy hypercube classifier was tested using two standard sets: Iris Flower and Wisconsin Diagnostic Breast Cancer. The network produced 88% and 76% correct classification, respectively. A speaker recognition system using a fuzzy hypercube classifier was also tested using the Switchboard and Greenflag databases. Test results are discussed.

DTIC

*Cancer; Classifications; Classifiers; Data Bases*

**19990008734** Naval Postgraduate School, Monterey, CA USA

**Two New Nearest Neighbor Classification Rules**

Karo, Ciril; Sep. 1998; 86p; In English

Report No.(s): AD-A354997; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Nearest Neighbor (NN) classification is a non-parametric discrimination and classification technique. In NN classification a test item is compared by some similarity measure of its multiple variables (usually a distance metric) with all the items in a training set. The class of the item to which it is most similar can be used as an indication of the class of the test item. In other words, the test item is assigned the class of its nearest neighbor. A key extension is the case when  $k > 1$  nearest neighbors (k-NN) are examined with the classification usually being made based on a plurality. NN classification is used in many fields, including for example the field of Pattern Recognition. Applications include tasks like speech recognition by a computer, medical data interpretation and diagnosis, or the interpretation of remote sensing imagery from satellites. Military applications of the technique include any situation where automated recognition is required. This thesis proposes two new NN rules that are intended to improve classification accuracy. The rules are tested against baseline classification methods in common use with a variety of data sets. One method shows improvement over the baseline methods in most of the data cases examined.

DTIC

*Accuracy; Analogies; Classifications; Diagnosis; Education; Imagery*



**19990008735** Naval Postgraduate School, Monterey, CA USA

**Forecasting Financial Markets Using Neural Networks: An Analysis of Methods and Accuracy**

Kutsurelis, Jason E.; Sep. 1998; 112p; In English

Report No.(s): AD-A355005; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This research examines and analyzes the use of neural networks as a forecasting tool. Specifically a neural network's ability to predict future trends of Stock Market Indices is tested. Accuracy is compared against a traditional forecasting method, multiple linear regression analysis. Finally, the probability of the model's forecast being correct is calculated using conditional probabilities. While only briefly discussing neural network theory, this research determines the feasibility and practicality of using neural networks as a forecasting tool for the individual investor. This study builds upon the work done by Edward Gately in his book *Neural Networks for Financial Forecasting*. This research validates the work of Gately and describes the development of a neural network that achieved a 93.3 percent probability of predicting a market rise, and an 88.07 percent probability of predicting a market drop in the S&P500. It was concluded that neural networks do have the capability to forecast financial markets and, if properly trained, the individual investor could benefit from the use of this forecasting tool.

DTIC

*Forecasting; Market Research; Neural Nets; Predictions*

**19990008904** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**The Study of Real-Time Visual Input Device for Robots**

Kurono, Shigeru, Kyushu Sangyo Univ., Japan; Fujino, Yoshikazu, Kyushu Sangyo Univ., Japan; Kitajina, Kenji, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 63-68; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In the researches for robotics, we usually need a high speed, low cost, and easy to use visual sensor which can be used to control a robot in real time. But just now, it is not easy to find such a real time visual input device in reasonable price. We developed an "Outline Image Processor" which is controlled by an 8 bits micro processor Z80 and able to take the coordinates (x,y) of the outline of objects into the memory in one field time of NTSC signal (16.7 ms). Moreover, the processor is able to compute the characteristic sizes and direction of the objects and transmit them to the host computer during next one field time.

Author

*Real Time Operation; Robots; Robotics*

**19990008960** NASA Lewis Research Center, Cleveland, OH USA

**Neural Network-Based Sensor Validation for Turboshift Engines**

Moller, James C., Miami Univ., USA; Litt, Jonathan S., NASA Lewis Research Center, USA; Guo, Ten-Huei, NASA Lewis Research Center, USA; Nov. 1998; 12p; In English; 34th; Propulsion, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 519-30-53; DA Proj. 1L1-61102-AH-45

Report No.(s): NASA/TM-1998-208824; NAS 1.15:208824; E-11432; ARL-TR-1817; AIAA Paper 98-3605; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sensor failure detection, isolation, and accommodation using a neural network approach is described. An auto-associative neural network is configured to perform dimensionality reduction on the sensor measurement vector and provide estimated sensor values. The sensor validation scheme is applied in a simulation of the T700 turboshaft engine in closed loop operation. Performance is evaluated based on the ability to detect faults correctly and maintain stable and responsive engine operation. The set of sensor outputs used for engine control forms the network input vector. Analytical redundancy is verified by training networks of successively smaller bottleneck layer sizes. Training data generation and strategy are discussed. The engine maintained stable behavior in the presence of sensor hard failures. With proper selection of fault determination thresholds, stability was maintained in the presence of sensor soft failures.

Author

*Turboshafts; Turbine Engines; Neural Nets; Feedback Control; Engine Control*

**19990008965** Lockheed Martin Corp., Advanced Technology Center, Palo Alto, CA USA

**Virtual Environments for Training Quarterly Report, 1 Apr - 30 Jun. 1998**

Stiles, R.; Jul. 1998; 59p; In English

Report No.(s): AD-A355853; VET-Q11-R3; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes the Lockheed-Martin VET team efforts and accomplishments during the eleventh quarter of the contract. Activity is reported for each of the software components of the Training Studio: VIVIDS, Steve, and Vista, as well as domain



development and evaluation study. This report contains material submitted for subcontracts by Dr. Allen Munro at USC/BTL, Dr. Lewis Johnson at USC/ISI. Progress on productization of the VET Training Studio software includes increased robustness for Vista virtual environment display and interaction services, a new capability to use the STEVE visual representation within VIV-IDS, and improved visual and spoken dialog capabilities for STEVE.

DTIC

*Computer Programs; Robustness (Mathematics); Virtual Reality; Software Engineering; Artificial Intelligence*

**19990008971** Army Research Lab., Sensors and Electron Devices Directorate, Adelphi, MD USA

**Matching Pursuit Filters Applied to Face Identification Interim Report, 1-30 Jun. 1997**

Phillips, P. J.; Oct. 1998; 42p; In English

Report No.(s): AD-A355718; ARL-TR-1487; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A face identification algorithm is presented that automatically processes an unknown image by locating and identifying the face. The heart of the algorithm is the use of pursuit filters. A matching pursuit filter is an adapted wavelet expansion, where the expansion is adapted to both the data and the pattern recognition problem being addressed. For identification, the filters find the features that differentiate among faces, whereas for detection, the filters encode the similarities among faces. The filters are designed through a simultaneous decomposition of a training set into a two-dimensional wavelet expansion. This yields a representation that is explicitly two-dimensional and encodes information locally. The algorithm uses coarse to fine processing to locate a small set of key facial features, which are restricted to the nose and eye regions of the face. The result is an algorithm that is robust to variations in facial expression, hair style, and the surrounding environment. Based on the locations of the facial features, the identification module searches the database for the identity of the unknown face using matching pursuit filters to make the identification. The algorithm was demonstrated on three sets of images. The first set was images from the FERET database. The second set was infrared and visible images of the same people. (These two sets allowed the examination of algorithm performance on infrared and visible images individually, and on fused data from both modalities.) The third set of images was mugshot data from a law enforcement application.

DTIC

*Infrared Imagery; Pattern Recognition; Wavelet Analysis*

**19990008975** Mitre Corp., Huntsville, AL USA

**Application of BMDO IS/T Distributed Computing and Simulation Research to BM/C3 Systems**

Smith, Stan M., Army Space and Missile Defense Command, USA; McFee, John K., Jr., Mitre Corp., USA; Hayes, James C., Colsa, Inc., USA; Weise, Maura Young, Colsa, Inc., USA; Jan. 1998; 7p; In English

Report No.(s): AD-A355741; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Ballistic Missile Defense Organization (BMDO) innovative Science and Technology (IS&T) Program sponsors research which is advancing the current state of the art in parallel discrete event simulation (PDES), high speed communications, distributed computing architectures, and automated decision support. This paper examines the application of these technologies to Theater Missile Defense (TMD) and National Missile Defense (NMD) Battle Management/Command Control and Communications (BM/C3) applications including real time battle planning and faster than real time defense evaluation. The requirement for performing faster than real time defense evaluation in future BM/C3 systems is derived from the understanding that a real time defense planning capability will require a faster than real time defense evaluation capability. This capability will require a mechanism for executing potentially hundreds of full scale system simulations with various threats, configurations, and resources in a sufficiently short amount of time that results can be evaluated and provided to the decision maker enabling more effective decision making on the battlefield. Research results are described demonstrating relevance of optimistic computing technology to performing faster than real time defense evaluation for TMD and NMD BM/C3 applications. Additionally, current efforts to merge and integrate IS&T sponsored optimistic computing and all optical deflection routing/distributed processing technologies are discussed.

DTIC

*Partial Differential Equations; Real Time Operation; Research and Development; Ballistic Missiles*

**19990009006** Nagoya Inst. of Tech., Japan

**Stop Consonants Recognition Using Dynamic Critical Band Spectra and a Neural Network**

Yogo, Hirofumi, Nagoya Inst. of Tech., Japan; Inagaki, Naoki, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 161-166; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper describes stop consonants recognition using dynamic critical band spectra and a three-layered neural network. Parameters of stop consonants were estimated by utilizing an adaptive digital filter (ADF) with fast convergence property, and were converted into critical band spectra similar to human hearing. The spectra were applied to a three layered neural network, and the stop consonants were identified. The learning property of the neural network was improved by giving common bias to the input-output functions of the network.

Author

*Spectral Bands; Digital Filters; Consonants (Speech); Adaptive Filters; Neural Nets*

**19990009059** Kentucky Univ., Research Foundation, Louisville, KY USA

**Stable Feature Extraction in Aerial Reconnaissance Images** *Final Report, 15 Aug. 1992 - 12 Aug 1996*

Chenoweth, Darrel L., Kentucky Univ., USA; Jun. 1998; 376p; In English

Contract(s)/Grant(s): N000140-92-J-4096

Report No.(s): AD-A355591; EEDPSCOR-01; No Copyright; Avail: CASI; A17, Hardcopy; A03, Microfiche

The problem of extracting stable features in aerial reconnaissance images is addressed in this report. Fractal models of image features are proposed and a concept of fractal error is introduced. Fractal error is a metric that quantifies the "closeness of fit" of the image feature to a fractal model. Using this metric one can discriminate between natural and man-made features in an image. Fractal error also presents a useful approach to extracting edges in images. Methods are given for computing and approximating fractal error using networks and genetic algorithms.

DTIC

*Aerial Reconnaissance; Genetic Algorithms; Pattern Recognition; Fractals*

## 64

## NUMERICAL ANALYSIS

*Includes iteration, difference equations, and numerical approximation.*

**19990008446** Universite Joseph Fourier, Grenoble, France

**Harmonic Maps Between Finite Graphs and a Theorem of Superrigidity** *Applications Harmoniques Entre Graphes Finis et un Theoreme de Superrigidite*

Lebeau, Edouard, Ecole Normale Superieure, France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1183-1203; In French; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We define the energy of a map between two finite metric graphs, and study the problem of minimizing the energy in a homotopy class. In this context, we prove analogues of Eells-Sampson's and Hartman's theorems concerning existence and uniqueness of harmonic maps into nonpositively curved manifolds. We also show that energy minimizing maps behave well under finite covering of the source. As an application of these results, we give a new (elementary) proof of a theorem of superrigidity for commensurability groups of tree lattices.

Author

*Analog; Homotopy Theory; Proving; Theorems*

**19990008448** Universite Joseph Fourier, Grenoble, France

**Remarks on the Differentials of the Uniform Polylogarithms** *Remarques sur les Differentielles des Polylogarithmes Uniformes*

Cathelineau, Jean-Louis, Nice Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1327-1347; In French; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The purpose of the article is to study functional equations for the differentials of polylogarithms. One of the main ingredients is an infinitesimal analogue of a complex introduced by Goncharov. As a result, one obtains a 22-term relation for the differential of the trilogarithm.

Author

*Differential Equations; Analog; Functions (Mathematics); Logarithms*

**19990008449** Universite Joseph Fourier, Grenoble, France

**Sharp  $L(\sup p)$ - $L(\sup q)$  Estimates for a Class of Averaging Operators** *Estimations  $L(\sup P)$ - $L(\sup Q)$  pour une Classe d'Operateurs Maximaux*

Iosevich, A., Wright State Univ., USA; Sawyer, A., McMaster Univ., Canada; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1359-1384; In English

Contract(s)/Grant(s): NSERC-OGP-0005149; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sharp  $L(\sup p)$  -  $L(\sup q)$  estimates are obtained for averaging operators associated to hypersurfaces in  $R(\sup n)$  given as graphs of homogeneous functions. An application to the regularity of an initial value problem is given.

Author

*Boundary Value Problems; Estimates; Graphs (Charts)*

**19990008450** Universite Joseph Fourier, Grenoble, France

**Minimal Surface Constructed by Gluing Scherk Surfaces** *Construction de Surfaces Minimales en Recollant des Surfaces de Scherk*

Traizet, Martin, Paris VII Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1385-1442; In French; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We construct simply periodic minimal surfaces in euclidean 3-space by gluing together Scherk surfaces, using the techniques of Kapouleas.

Author

*Euclidean Geometry; Minimal Surfaces; Boundary Value Problems*

**19990008452** Universite Joseph Fourier, Grenoble, France

**From Poisson Algebras to Gerstenhaber Algebras** *Des Algebres de Poisson aux Algebres de Gerstenhaber*

Kosmann-Schwarzbach, Yvette, Ecole Polytechnique, France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1243-1274; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Constructing an even Poisson algebra from a Gerstenhaber algebra by means of an odd derivation of square 0 is shown to be possible in the category of Loday algebras (algebras with a non-skew-symmetric bracket, generalizing the Lie algebras, heretofore called Leibniz algebras in the literature). Such "derived brackets" give rise to Lie brackets on certain quotient spaces, and also on certain Abelian subalgebras. The construction of these derived brackets explains the origin of the Lie bracket on the space of co-exact differential forms on a Poisson manifold.

Author

*Poisson Equation; Algebra; Brackets*

**19990008453** Universite Joseph Fourier, Grenoble, France

**Universal Taylor Series** *Series de Taylor Universelles*

Nestoridis, Vassili, Orleans Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1293-1306; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We strengthen a result of Chui and Parnes and we prove that the set of universal Taylor series is a  $G(\delta)$ -dense subset of the space of holomorphic functions defined in the open unit disc. Our result provides the answer to a question stated by S.K. Pichorides concerning the limit set of Taylor series. Moreover, we study some properties of universal Taylor series and show, in particular, that they are trigonometric series in the sense of D. Menchoff.

Author

*Analytic Functions; Taylor Series; Trigonometric Functions*

**19990008456** Universite Joseph Fourier, Grenoble, France

**On Boundary Slopes of Immersed Incompressible Surfaces** *Sur les Pentés a Bord des Surfaces Essentielles Immergees*

Baker, Mark D., Rennes Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1443-1449; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Let  $M$  be a compact, orientable, irreducible 3-manifold with  $(\delta)M$  a torus. We show that there can be infinitely many slopes on  $(\delta)M$  realized by the boundary curves of immersed, incompressible,  $\delta$ -incompressible surfaces in  $M$  which are embedded in a neighborhood of  $M$ .

Author

*Manifolds (Mathematics); Slopes; Boundaries*

**19990008475** Universite Joseph Fourier, Grenoble, France

**On the Distribution of the Roots of Polynomials** *Sur la Distribution des Racines des Polynomes*

Amoroso, F., Pisa Univ., Italy; Mignotte, M., Pasteur (Louis) Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1275-1291; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using classical results on conjugate functions, we give very short proofs of theorems of Erdos-Turan and Blatt concerning the angular distribution of the roots of polynomials. Then we study some examples.

Author

*Theorem Proving; Polynomials; Angular Distribution; Roots of Equations*

**19990008714** Cincinnati Univ., OH USA

**High Speed, Numerically Superior Signal Processing Algorithms Using QRD & Delta Operator** *Annual Report, 1 Oct. 1997 - 30 Sep. 1998*

Fan, Howard; Sep. 1998; 7p; In English

Contract(s)/Grant(s): N00014-96-1-0241

Report No.(s): AD-A354817; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Several research topics related to the delta operator have been studied. First, our research on the delta operator based efficient stability tests is being wrapped up and concluded. We have revised and published a few papers on various aspects of this topic. Second, we have completed the development of a delta operator based least squares lattice algorithm, which is computationally efficient and numerically better than an existing algorithm. The work is completed during this period and some papers have been submitted/published. Third, we continued to work on the generalized delta operator in the identification of continuous time AR process parameters. We have studied the use of the generalized delta operator in a noisy environment, and have investigated integrated sampling and its effectiveness in coping with noise. Other topics such as blind equalization and wavelet based time varying system modeling have also been studied.

DTIC

*Algorithms; High Speed; Sampling*

**19990008949** NASA Lewis Research Center, Cleveland, OH USA

**Nonlinear Comparison of High-Order and Optimized Finite-Difference Schemes**

Hixon, R., NASA Lewis Research Center, USA; Oct. 1998; 22p; In English

Contract(s)/Grant(s): NCC3-531; RTOP 523-36-13

Report No.(s): NASA/CR-1998-208670; NAS 1.26:208670; ICOMP-98-05; E-11393; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effect of reducing the formal order of accuracy of a finite-difference scheme in order to optimize its high-frequency performance is investigated using the I-D nonlinear unsteady inviscid Burgers' equation. It is found that the benefits of optimization do carry over into nonlinear applications. Both explicit and compact schemes are compared to Tam and Webb's explicit 7-point Dispersion Relation Preserving scheme as well as a Spectral-like compact scheme derived following Lele's work. Results are given for the absolute and L2 errors as a function of time.

Author

*Finite Difference Theory; Wave Dispersion; Time Dependence; Nonlinear Equations*

**19990009015** Nagoya Inst. of Tech., Japan

**Expansions into Series of Spherical Harmonics**

Nakai, Mitsuru, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 101-116; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The purpose of this paper is to establish the following result: If  $f$  is a function on the unit sphere in the Euclidean space of dimension  $d$  greater than or equal to 3 which is at least  $-2$   $[-d/4]$  times continuously differentiable, then  $f$  can be expanded into the absolutely and uniformly convergent Fourier series of spherical harmonics on the unit sphere, where  $[\ ]$  is the Gaussian symbol.

Author

*Expansion; Spherical Harmonics; Euclidean Geometry*

**19990009021** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Numerical Solution of the Korteweg-de Vries Equation by Spline Expansion Method**

Aoyagi, Akira, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 89-96; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

For the numerical solution of the Korteweg-deVries equation, an expansion method by use of spline functions is proposed. The phase error of the spline expansion method is remarkably small compared with that of the Zabusky-Kruskal scheme. Comparing with the exact analytical solution or with the solution by the Fourier-expansion method, the spline expansion method is found to give a quite accurate solution, even in the case where the amplitude of wave is comparatively large.

Author

*Korteweg-Devries Equation; Splines; Spline Functions; Numerical Analysis; Iterative Solution*

**19990009053** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Eigenmode Analysis of Boundary Conditions for One-Dimensional Preconditioned Euler Equations *Final Report***

Darmofal, David L., Institute for Computer Applications in Science and Engineering, USA; Nov. 1998; 14p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-1998-208741; NAS 1.26:208741; ICASE-98-51; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis of the effect of local preconditioning on boundary conditions for the subsonic, one-dimensional Euler equations is presented. Decay rates for the eigenmodes of the initial boundary value problem are determined for different boundary conditions. Riemann invariant boundary conditions based on the unpreconditioned Euler equations are shown to be reflective with preconditioning, and, at low Mach numbers, disturbances do not decay. Other boundary conditions are investigated which are non-reflective with preconditioning and numerical results are presented confirming the analysis.

Author

*Boundary Conditions; Boundary Value Problems; Euler Equations of Motion*

**19990009054** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Bounded Error Schemes for the Wave Equation on Complex Domains *Final Report***

Abarbanel, Saul, Tel-Aviv Univ., Ramat-Aviv, Israel; Ditkowski, Adi, Tel-Aviv Univ., Ramat-Aviv, Israel; Yefet, Amir, Tel-Aviv Univ., Ramat-Aviv, Israel; Nov. 1998; 16p; In English

Contract(s)/Grant(s): NAS1-19480; NAS1-97046; F49620-95-I-0074; DE-FG02-95ER-25239; RTOP 505-90-52-01

Report No.(s): NASA/CR-1998-208740; NAS 1.26:208740; ICASE-98-50; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper considers the application of the method of boundary penalty terms ("SAT") to the numerical solution of the wave equation on complex shapes with Dirichlet boundary conditions. A theory is developed, in a semi-discrete setting, that allows the use of a Cartesian grid on complex geometries, yet maintains the order of accuracy with only a linear temporal error-bound. A numerical example, involving the solution of Maxwell's equations inside a 2-D circular wave-guide demonstrates the efficacy of this method in comparison to others (e.g. the staggered Yee scheme) - we achieve a decrease of two orders of magnitude in the level of the L2-error.

Author

*Wave Equations; Maxwell Equation; Dirichlet Problem; Cartesian Coordinates; Boundary Conditions*

**19990009055** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**A Rigorous Framework for Optimization of Expensive Functions by Surrogates *Final Report***

Booker, Andrew J., Boeing Aerospace Co., USA; Dennis, J. E., Jr., Rice Univ., USA; Frank, Paul D., Boeing Aerospace Co., USA; Serafini, David B., California Univ., Lawrence Berkeley Lab., USA; Torczon, Virginia, Institute for Computer Applications in Science and Engineering, USA; Trosset, Michael W., Institute for Computer Applications in Science and Engineering, USA; Nov. 1998; 22p; In English; Sponsored in part by the REDI Foundation

Contract(s)/Grant(s): NAS1-19480; NAS1-97046; DE-FG03-93ER-25178; F49620-95-I-0210; NSF CCR-91-20008; NSF CCR-97-31044; RTOP 505-90-52-01

Report No.(s): NASA/CR-1998-208735; NAS 1.26:208735; ICASE-98-47; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The goal of the research reported here is to develop rigorous optimization algorithms to apply to some engineering design problems for which design application of traditional optimization approaches is not practical. This paper presents and analyzes a framework for generating a sequence of approximations to the objective function and managing the use of these approximations as surrogates for optimization. The result is to obtain convergence to a minimizer of an expensive objective function subject to simple constraints. The approach is widely applicable because it does not require, or even explicitly approximate, derivatives of



the objective. Numerical results are presented for a 31-variable helicopter rotor blade design example and for a standard optimization test example.

Author

*Design Analysis; Rotary Wings; Optimization; Computer Design*

## 65

### STATISTICS AND PROBABILITY

*Includes data sampling and smoothing: Monte Carlo method; and stochastic processes.*

**19990008455** Universite Joseph Fourier, Grenoble, France

**Necessary and Sufficient Conditions for Matrix Summability Methods to be Stronger Than Multisummability** *Conditions Necessaires et Suffisantes qui Rendent les Methodes Matricielles Plus Fortes que la Multisommabilite*

Balser, W., Ulm Univ., Germany; Beck, A., Ulm Univ., Germany; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1349-1357; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

For general matrix summability methods, we find necessary and sufficient conditions for such methods to be stronger than multisummability. In a second part we show the existence of power series which are not multisummable but can be summed by a matrix method satisfying the conditions mentioned above.

Author

*Matrix Methods; Power Series; Sums*

**19990008947** State Univ. of New York, Office of Research and Sponsored Programs, Binghamton, NY USA

**Statistical Modeling with Imprecise Probabilities** *Final Report, Jul. 1994 - Aug. 1997*

Klir, George J., State Univ. of New York, USA; Aug. 1998; 47p; In English

Contract(s)/Grant(s): F30602-94-1-0011; AF Proj. 4600

Report No.(s): AD-A354584; AFRL-IF-RS-TR-1998-166; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this project is to develop theoretical foundations, based upon the broad framework of the theory of fuzzy measures, and methodology, supported by appropriate computer software, for systems modeling with imprecise probabilities of various kinds. This objective is motivated by the recognition that the assumption that relevant probabilities can be assessed precisely is highly unrealistic. The results are loosely classified into the following seven areas: (1) Complete methodology for Bayesian inference based upon interval valued or fuzzy probabilities and likelihoods; (2) Well justified information measure in Dempster Shafer theory; (3) Relevant theoretical results in fuzzy measure theory, a theory that is connected with imprecise probabilities in a similar way as classical measure theory is connected with classical probabilities; (4) Procedures for constructing imprecise probabilities and fuzzy measures by various methods, including the use of neural networks and genetic algorithms; (5) Various other theoretical results that emerged from the work on the project, including (a) Complete representations of Dempster Shafer theory and possibility theory in terms of the usual semantics of propositional modal logic, (b) Basic ideas of mathematics of finite resolution, (c) Constrained fuzzy arithmetic, (d) A method for identifying key variables in systems modeling via fuzzy c-means clustering based on varying distance function, and (e) A thorough mathematical analysis of the well known Cox's proof, by which it is shown that the proof does not demonstrate the inevitability of the rules of classical Bayesian inference, as often claimed; (6) Applications of the Bayesian inference with fuzzy probabilities to the problem of military unit identification and to statistical decision making; and (7) Computer programs for some algorithms that emerged from the work on this project.

DTIC

*Statistical Analysis; Probability Theory*

**19990008987** Instituto Nacional de Pesquisas Espaciais, Sao Jose dos Campos, Brazil

**Insertion of Phase Type Distributions in Markov Decision Models** *Insercao de Distribuicoes do Tipo Fase em Modelos Markovianos de Decisao*

deCassiaMenesesRodrigues, Rita, Instituto Nacional de Pesquisas Espaciais, Brazil; Jun. 1998; 144p; In Portuguese

Report No.(s): INPE-6480-TDI/648; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Phase type distributions (PH distributions) approximate as well as any continuous positive probability distribution. Due to their features, these distributions can be easily used in Decision Markov Models provided that their phases can be observed. However, in case phases cannot be observed, no bibliography is available to show a solution for the problem of inserting PH distributions in Continuous Time Markov Decision Processes. The objective of this work is to present a solution for this problem. A methodology using the theory of Decision Markov Processes with Partial Information is proposed. Numerical results are shown

where the proposed methodology is applied to optimizing a maintenance model in which repair times are not exponential and to optimizing the control in a PH/PH/1/N queue.

Author

*Ph; Markov Processes; Probability Theory*

**19990009014** Nagoya Inst. of Tech., Japan

**A Simple Proof of Absolute Continuity of Multivariate Operator-Self-decomposable Distributions**

Yamazato, Makoto, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 117-120; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper, a simple alternative proof of absolute continuity of genuinely d-dimensional operator-selfdecomposable distributions on  $R(\sup d)$  is given.

Derived from text

*Multivariate Statistical Analysis; Theorem Proving; Continuity (Mathematics); Operators (Mathematics); Distribution Functions*

**66**

**SYSTEMS ANALYSIS**

*Includes mathematical modeling; network analysis; and operations research.*

**19990008500** Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia

**Critical Path Analysis of Command and Control Support**

Davies, Mike, Defence Science and Technology Organisation, Australia; Taylor, Samuel, Australian National Univ., Australia; Jun. 1998; 48p; In English

Report No.(s): DSTO-TR-0678; DODA-AR-010-559; Copyright; Avail: Issuing Activity (DSTO Electronics and Surveillance Research Lab., PO Box 1500, Salisbury, South Australia 5108), Hardcopy, Microfiche

The Command and Control (C2) Support Study (C2SS) was established to assess the strengths and weaknesses of ADF C2 support and analyse options for addressing the identified weaknesses. Scope for employing critical path analysis capabilities to assist the C2SS in data management, reporting and analysis has been determined. This document conveys the capabilities and associated opportunities through the use of a collection of unclassified examples based on invented data for a Defence of Australia scenario used in the C2SS.

Author

*Command and Control; Critical Path Method; Data Management; Management Analysis*

**19990008708** RAND Corp., Santa Monica, CA USA

**Experiments in Multiresolution Modeling (MRM)**

Davis, Paul K.; Bigelow, James H.; Jan. 1998; 83p; In English

Contract(s)/Grant(s): DASW01-95-C-0059

Report No.(s): AD-A355041; RAND/MR-1004-DARPA; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report describes final results of a small project sponsored by the Defense Advanced Research Projects Agency (DARPA), the intention of which was to identify useful directions for further work on multiresolution modeling (MRM). The work was largely accomplished in the Applied Sciences and Technology Center of RAND's National Defense Research Institute (NDRI), a federally funded research and development center (FFRDC) sponsored by the Office of the Secretary of Defense, the Joint Staff, the unified commands, and the defense agencies. Some of the modeling reflected here in simplified form was accomplished in the "Planning Future Forces" and "Transforming the Force" projects sponsored by NDRI's advisory board. NDRI also provided additional research-support funding to complete the work and present it at conferences.

DTIC

*Image Resolution; Mathematical Models*

**19990008974** Sparta, Inc., Arlington, VA USA

**Comparison of Filtering Options for Ballistic Coefficient Estimation**

Jesionowski, Robert, Sparta, Inc., USA; Zarchan, Paul, Draper (Charles Stark) Lab., Inc., USA; Jan. 1998; 8p; In English

Report No.(s): AD-A355740; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The capabilities of a linear decoupled Kalman filter and two extended Kalman filters were examined when tracking an object as it enters the atmosphere. The filters were given identical radar range and elevation data. The first extended filter estimates the position, velocity, and inverse ballistic coefficient; the second estimates position, velocity and the ballistic coefficient. The linear filter estimates position, velocity and acceleration and derives the ballistic coefficient from those estimates. The paper will show that the performance of the linear filter is inferior to that of the extended filters, while the performances of the extended filters are nearly identical.

DTIC

*Kalman Filters; Linear Filters; Radar Range*

**19990008977** Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia  
**Application of Game Theory to Tactical Development in Simulation Studies**

Hanlon, Brian, Defence Science and Technology Organisation, Australia; Aug. 1998; 26p; In English

Report No.(s): AD-A355763; DSTO-TR-0706; DODA-AR-010-606; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sophisticated simulation models provide powerful tools with which to study the development and outcomes of highly interactive scenarios involving multiple players. The effectiveness of such outcomes, however, is strongly dependent on the set of tactics available to the players involved. Game Theory provides a framework in which optimal tactics can be developed in adversarial domains. Rather than constructing complete mathematical solutions, this report investigates how broad analysis within the scope of Game Theory can be used to provide insight into an operational scenario. When such an insight is gained into the general properties of an optimal solution the knowledge acquired can be applied as input5 to relevant simulation models. In this way simulation tools can be more effectively brought to bear on complex real world problems. This approach is investigated through the analysis of a simple tactical scenario.

DTIC

*Computerized Simulation; Domains; Simulation*

## 67

### THEORETICAL MATHEMATICS

*Includes topology and number theory.*

**19990008447** Universite Joseph Fourier, Grenoble, France

**Fourier-Deligne Transformation on Unipotent Groups** *Transformation de Fourier-Deligne sur les Groupes Unipotents*

Saibi, Moussa, Picardie Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1205-1242; In French; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper, we study the Fourier-Deligne transformation on commutative unipotent connected group schemes over a perfect field. We recall the construction of Serre's dual for a commutative unipotent connected group scheme and we set the notion of admissible dual pairs for a commutative unipotent group scheme over a perfect field. Then we define the Fourier-Deligne transformation on these dual pairs and we study the elementary properties of this functor: the involutivity, the commutation with base change and compatibility with convolution product. Then, we prove the main result of this paper: we show that this transformation commutes with Verdier duality and preserves the abelian category of perverse sheaves.

Author

*Fourier Transformation; Operators (Mathematics); Construction*

**19990008451** Universite Joseph Fourier, Grenoble, France

**Anosov Flows on Graph Manifolds in the Sense of Waldhausen** *Flots d'Anosov sur les Varietes Graphees au sens de Waldhausen*

Barbot, Thierry, Bourgogne Univ., France; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1451-1517; In French; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper is devoted to the study of a wide class of Anosov flows on graph manifolds. We establish a general result about embeddings of Seifert manifolds in 3-dimensional manifolds admitting a product Anosov flow, generalizing a previous result of E. Ghys. We show that up to isotropy the restriction of the one-dimensional foliation defined by the flow to the image of this embedding is topologically conjugate to a piece of a geodesic flow outside a finite number of periodic orbits. We show more: the conjugacy can be chosen such that it respects the restrictions of the weak foliations. We next give a topological characterization of the examples of Handel-Thurston. Essentially, they are the unique Anosov flows on graph manifolds such that no periodic orbit

is freely homotopic to the fiber of some embedded Seifert manifold in the graph manifold. Eventually, we exhibit the first known examples of graph manifolds which are not Seifert spaces nor torus bundles over the circle, whose fundamental groups are of exponential growth and admitting no Anosov flow.

Author

*Manifolds (Mathematics); Conjugates; Bundles; Circles (Geometry)*

**19990008454** Universite Joseph Fourier, Grenoble, France

**Partial Indices of Analytic Discs Attached to Lagrangian Submanifolds of  $C(\sup N)$**  *Les Indices Partiels des Disques Analytiques Attaches aux Sous-Varietes Langrangiennes de  $C(\sup N)$*

Globevnik, Josip, Ljubljana Univ., Yugoslavia; Annales de l'Institut Fourier; 1996; ISSN 0373-0956; Volume 46, No. 5, pp. 1307-1326; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Integers  $k_1, \dots, k_N$  are the partial indices of an analytic disc attached to a maximally real submanifold of  $C(\sup N)$  if and only if  $k_j \geq 2$  for at least one  $j$ . If this is the case there is a Lagrangian submanifold  $M$  of  $C(\sup N)$  and an analytic disc attached to  $M$  with partial indices  $k_1, \dots, k_N$ .

Author

*Integers; Lagrangian Function; Analytic Functions*

**19990009008** Nagoya Inst. of Tech., Japan

**On Transformations to Clausal Forms in the Predicate Calculus**

Nagata, Shuro, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 167-172; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In the preparation stage for proof procedures each sentence in the first order predicate calculus is transformed to a suitable normal form. A very convenient and effective normal form is a clausal form. The first method for transformation to clausal forms is presented by Davis and Putnam. This transformation method is used by many researchers of automated theorem proving as yet. We shall present other methods for transformations for not only refutation procedures but also affirmation procedures.

Author

*Theorem Proving; Predicate Calculus*

**19990009016** Nagoya Inst. of Tech., Japan

**Spectrum of a Complete Riemannian Manifold with an Amenable Group Action I**

Adachi, Toshiaki, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 93-100; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Let  $X$  be a complete Riemannian manifold. Suppose there exists a discrete subgroup  $\Gamma$  of the isometry group of  $X$  which acts freely and properly discontinuously, and whose orbit space  $M = \Gamma \backslash X$  is compact. We consider a sequence  $\{M_k\}$  of finite coverings based on  $M$ . We show in this paper that the spectrum of  $X$  is contained in the closure of the union of the spectrum of  $M_k$ . We also show that these sets coincide with each other if and only if  $\Gamma$  is amenable.

Author

*Riemann Manifold; Spectra*

**19990009017** Nagoya Inst. of Tech., Japan

**Circular Geodesic Submanifolds of a Complex Space Form**

Maeda, Sadahiro, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 87-91; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper, we investigate Riemannian submanifolds  $M$  of a non-flat complex space form  $\bar{M}$  in terms of behavior of geodesics  $\gamma$  of  $M$ . From this point of view, a totally geodesic submanifold  $M$  of  $\bar{M}$  (that is, every geodesic  $\gamma$  of  $M$  is also a geodesic in  $\bar{M}$ ) can be regarded as the simplest one. So, it is natural to consider circular geodesic submanifolds  $M$  of  $\bar{M}$  (that is, every geodesic  $\gamma$  of  $M$  is a circle in  $\bar{M}$ ). The following problem is still open: Classify circular geodesic submanifolds  $M$  in a complex space form. The purpose of this paper is to survey some results on this problem.

Author

*Manifolds (Mathematics); Circles (Geometry); Geodesic Lines*

70  
**PHYSICS (GENERAL)**

*For precision time and time interval (PTI) see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.*

**19990008905** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Steady State Oscillations of the System with a Dead Zone Element: Improvement of the Convergence**

Matsumoto, Katsuya, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 69-72; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The analysis of the nonlinear oscillatory system with a dead zone element is not easy to accomplish, because of the sensitive phenomena of the nonlinear oscillation. Especially, it is difficult to get the steady state oscillations in an almost lossless system. We proposed previously a numerical analysis by which the Runge-Kutta method and the Newton-Raphson method had been combined. The numerical solutions almost converged in the actual parameter area except the region of very small dissipation. In this paper, the cause of no convergence is clarified and the algorithm is improved. All of the solutions of the system at very light load were obtained by the new algorithm.

Author

*Steady State; Oscillations; Convergence; Runge-Kutta Method; Newton-Raphson Method*

**19990008938** Colorado Univ., Dept. of Mechanical Engineering, Boulder, CO USA

**Three-Dimensional in Situ Stress Analysis of Rock Masses Perturbed by Irregular Topographies and Underground Openings Final Report, 15 Nov. 1997 - 14 Nov. 1998**

Pan, Ernian, Colorado Univ., USA; Amadei, Bernard, Colorado Univ., USA; Oct. 31, 1998; 34p; In English

Contract(s)/Grant(s): F49620-98-1-0104

Report No.(s): AD-A354832; 1536606; AFRL-SR-BL-TR-98-0668; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The overall goal of this project is to develop a new and efficient boundary element method (BEM) program for the stress analysis of 3-D anisotropic rock masses that are perturbed by irregular topographies and underground openings. This stress analysis will provide direct information on the best (or optimal) selection of the surface location and hit angle for a penetrator. We have identified three tasks to achieve this goal, which include theoretical and analytical development; computational and numerical development; and laboratory investigation and field validation. This final technical report presents our accomplishments related to the first and second tasks, that is, the theoretical and analytical development, and computational and numerical development. First, the analytical solution and numerical implementation are presented for elastostatic displacement Green's function for 3D rock masses of general anisotropy. Excerpts from the authors' FORTRAN code are included. A numerical algorithm for the calculation of the derivatives of the Green's displacements and stresses is also introduced. Secondly, these Green's functions are incorporated into a BEM code developed by the authors. Thirdly, numerical results of Green's displacements, stresses and stress derivatives are presented and compared to the closed-form solutions for transversely isotropic rocks. Finally, the BEM code based on the current Green's functions is tested and the numerical results are compared to those using a BEM code based on the exact Green's functions. It is shown that the Green's functions derived in this report are accurate and the corresponding BEM code is correct. This BEM code is now ready for the laboratory comparison and field validation.

DTIC

*Stress Analysis; Rocks; Openings; Boundary Element Method; Anisotropy*

**19990009020** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Magnetic Relaxation on Minor Magnetization Loop**

Kawaguchi, Hajime, Kyushu Sangyo Univ., Japan; Akune, Tadahiro, Kyushu Sangyo Univ., Japan; Sakamoto, Nobuyoshi, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 121-128; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Flux creep behaviors are continued redistributions of magnetic flux densities caused by the thermally activated fluctuations. Overshooting of an applied magnetic field, which set the magnetization point from  $B_{(sub\ o)}$  on the major loop to  $B_{(sub\ o)} - \Delta B_{(sub\ m)}$  on the minor loop, is known experimentally to reduce the creep rate drastically. This can be a useful procedure to suppress the large creep rate in high-temperature superconductors. The creep characteristics on the minor loops were systematically observed in platinum doped melt growth YBaCuO superconductors at temperatures of 60 and 77 K. For a small  $\Delta B_{(sub\ m)}$  magnetizations were almost constant for a period of time and then declined to the logarithmic time dependence. An increase of the absolute value of magnetization has also been observed. With the further increase of  $\Delta B_{(sub\ m)}$  the creep characteristics



approached that of the normal one on a next major curve. These behaviors can be explained by considering a barrier magnetization  $\Delta M(\text{sub br})$  appearing near surfaces in the process of the minor loops.

Author

*Magnetic Relaxation; Magnetization; Loops; Flux Density*

## 71 ACOUSTICS

*Includes sound generation, transmission and attenuation. For noise pollution see 45 Environmental Pollution.*

**19990008649** NASA Lewis Research Center, Cleveland, OH USA

### **A Fan Concept to Meet the 2017 Noise Goals**

Dittmar, James H., NASA Lewis Research Center, USA; Nov. 1998; 16p; In English

Contract(s)/Grant(s): RTOP 538-03-11

Report No.(s): NASA /TM-1998-208663; E-11384; NAS 1.15:208663; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration has established a goal of a 20 EPNdB reduction of aircraft noise by the year 2017. This paper proposes a fan concept for an engine that may meet this noise goal. The concept builds upon technology established during the Advanced Subsonic Technology Program which should show a 10 dB reduction potential. The new concept uses a two stage fan which allows low tip speed while still maintaining a reasonable total pressure rise across the two stages. The concept also incorporates many other noise reduction techniques in addition to low tip speed including a low number of exit guide vanes, swept and leaned guide vanes, a high subsonic Mach number inlet and syncrophased rotors to obtain active noise cancellation. The fan proposed in this paper is calculated to be able to achieve the 2017 noise goal.

Author

*Noise Reduction; Aircraft Noise; Compressors; Engine Noise; Design Analysis*

**19990008660** NASA Lewis Research Center, Cleveland, OH USA

### **High-Accuracy Compact MacCormack-Type Schemes for Computational Aeroacoustics**

Hixon, R., NASA Lewis Research Center, USA; Turkel, E., NASA Lewis Research Center, USA; Oct. 1998; 36p; In English

Contract(s)/Grant(s): NCC3-531; RTOP 523-36-13

Report No.(s): NASA/CR-1998-208672; NAS 1.26:208672; ICOMP-98-07; E-11396; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using MacCormack-type methods, a new class of highly accurate compact MacCormack-type schemes is derived which does not require a tridiagonal matrix inversion to obtain the spatial derivatives. Two examples are shown, and results of these schemes for three linear and nonlinear CAA Benchmark Problems are presented.

Author

*Aeroacoustics; Matrices (Mathematics); Aircraft Noise; Screech Tones*

**19990008723** Washington Univ., Applied Physics Lab., Seattle, WA USA

### **Final Report on Numerical Study of Rough Surface Scattering Final Report**

Thorsos, Eric I.; Oct. 12, 1998; 3p; In English

Contract(s)/Grant(s): N00014-96-1-0215

Report No.(s): AD-A354759; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Under the subject grant titled "Numerical Study of Rough Surface Scattering" research was conducted on rough surface scattering using an exact numerical method based on solving an integral equation. Boundary conditions appropriate to both sea surface and sea bottom scattering were employed. Numerical studies were used to examine the accuracy of approximations used with scattering theory, and various scattering phenomena were examined directly with numerical simulations and modeling. One important highlight from this work is that numerical simulations were used to show that roughness at the water/sediment interface could lead to significant acoustic penetration into sediment at incident grazing angles below the critical angle. This work played an important part in the development of the High Frequency Sediment Acoustics DRI which began in FY98.

DTIC

*Acoustics; Boundary Conditions; High Frequencies; Integral Equations; Ocean Surface; Penetration*

**19990008954** DYNACS Engineering Co., Inc., Brook Park, OH USA

**Nonlinear Interaction of Detuned Instability Waves in Boundary-Layer Transition: Amplitude Equations** *Final Report*

Lee, Sang Soo, DYNACS Engineering Co., Inc., USA; Oct. 1998; 86p; In English

Contract(s)/Grant(s): NAS3-98008; RTOP 538-03-11

Report No.(s): NASA/CR-1998-208679; NAS 1.26:208679; E-11416; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The non-equilibrium critical-layer analysis of a system of frequency-detuned resonant-triads is presented. In this part of the analysis, the system of partial differential critical-layer equations derived in Part I is solved analytically to yield the amplitude equations which are analyzed using a combination of asymptotic and numerical methods. Numerical solutions of the inviscid non-equilibrium oblique-mode amplitude equations show that the frequency-detuned self-interaction enhances the growth of the lower-frequency oblique modes more than the higher-frequency ones. All amplitudes become singular at the same finite downstream position. The frequency detuning delays the occurrence of the singularity. The spanwise-periodic mean-flow distortion and low-frequency nonlinear modes are generated by the critical-layer interaction between frequency-detuned oblique modes. The nonlinear mean flow and higher harmonics as well as the primary instabilities become as large as the base mean flow in the inviscid wall layer in the downstream region where the distance from the singularity is of the order of the wavelength scale.

Author

*Nonlinearity; Numerical Analysis; Stability; Harmonics; Flow Distortion; Equilibrium Equations; Boundary Layer Transition; Asymptotic Methods*

**19990008958** NASA Lewis Research Center, Cleveland, OH USA

**A Fan Concept to Meet the 2017 Noise Goals**

Dittmar, James H., NASA Lewis Research Center, USA; Nov. 1998; 16p; In English

Contract(s)/Grant(s): RTOP 538-03-11

Report No.(s): NASA/TM-1998-208663; NAS 1.15:208663; E-11384; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Aeronautics and Space Administration has established a goal of a 20 EPNdB reduction of aircraft noise by the year 2017. This paper proposes a fan concept for an engine that may meet this noise goal. The concept builds upon technology established during the Advanced Subsonic Technology Program which should show a 10 dB reduction potential. The new concept uses a two stage fan which allows low tip speed while still maintaining a reasonable total pressure rise across the two stages. The concept also incorporates many other noise reduction techniques in addition to low tip speed including a low number of exit guide vanes, swept and leaned guide vanes, a high subsonic Mach number inlet and synchrophased rotors to obtain active noise cancellation. The fan proposed in this paper is calculated to be able to achieve the 2017 noise goal.

Author

*Noise Reduction; Aircraft Noise; Guide Vanes; Mach Number; Rotors; Tip Speed*

**19990008966** Texas Univ., Applied Research Labs., Austin, TX USA

**Acoustic Localization and Decay of the Incoherent Impulse Response** *Final Report, 1 Nov. 1997 - 31 Oct. 1998*

Smith, Eric; Nov. 02, 1998; 6p; In English

Contract(s)/Grant(s): N00014-98-1-0118

Report No.(s): AD-A355854; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Applied Research Laboratories, The University of Texas at Austin (ARL:UT) was tasked to study the effects of strong random scattering in acoustic media with macroscopically non-uniform scattering strengths. A statistical, field-theoretic method, previously applied in condensed matter physics and seismology, was introduced to study these effects analytically. Non-uniform random scattering was found to produce phenomena closely related to acoustic localization, which results from uniform scatter. However, non-uniformity also introduces new qualitative signatures not found in localizing systems, including exponential decay of the incoherent impulse response, with universal scaling of the decay time constant. These predictions match features long known empirically to characterize earthquake coda, but not previously explained. The seismic data thus validate the new mathematical techniques, and also introduce useful ways to characterize random scattering within sediments.

DTIC

*Sediments; Scattering; Earthquakes; Seismology; Statistical Analysis*

*Includes atomic structure, electron properties, and molecular spectra.*

**19990008608** NASA Langley Research Center, Hampton, VA USA

**Small Vacuum Compatible Hyperthermal Atom Generator**

Outlaw, Ronald A., Inventor, NASA Langley Research Center, USA; Davidson, Mark R., Inventor, NASA Langley Research Center, USA; Nov. 10, 1998; 18p; In English

Patent Info.: Filed 15 Aug. 1996; NASA-Case-LAR-15338-2; US-Patent-5,834,768; US-Patent-Appl-SN-698541; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A vacuum compatible hyperthermal atom generator includes a membrane having two sides. the membrane having the capability of dissolving atoms into the membrane's bulk. A first housing is furnished in operative association with the first side of the membrane to provide for the exposure of the first side of the membrane to a gas species. A second housing is furnished in operative association with the second side of the membrane to provide a vacuum environment having a pressure of less than  $1 \times 10(\exp -3)$  Torr on the second side of the membrane. Exciting means excites atoms adsorbed on the second side of the membrane to a non-binding state so that a portion from 0% to 100% of atoms adsorbed on the second side of the membrane are released from the second side of the membrane primarily as an atom beam.

Author

*Atomic Beams; Gas Composition; Membranes; Vacuum Chambers; Particle Diffusion; Vacuum Systems*

**19990008855** Massachusetts Inst. of Tech., Lab. of Electronics, Cambridge, MA USA

**Atom Wave Interferometers Final Report, 1 Dec. 1995 - 30 Sep. 1998**

Pritchard, David E.; Nov. 02, 1998; 17p; In English

Contract(s)/Grant(s): N00014-96-1-0432

Report No.(s): AD-A355744; 96PR02195-00; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Atom interferometers have proven to be versatile tools, applicable in many different scientific and technical arenas. We have concentrated our efforts in the three major areas of precision measurements of important quantities in atomic physics, basic research into atom interferometric inertial sensors, and investigations of fundamental quantum mechanical principles.

DTIC

*Interferometry; Atomic Physics; Interferometers*

**19990009003** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Generation of Pulsed Radical Beams and their Spectroscopic Observation**

Nishimura, Yukio, Kyushu Univ., Japan; Nakano, Naohiko, Kyushu Univ., Japan; Ujita, Hiroki, Kyushu Univ., Japan; Sekiya, Hiroshi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 35-40; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Pulsed radical beam apparatus has been constructed. Diatomic radicals have been studied by using laser-induced fluorescence and multiphoton ionization methods. Rotationally-cooled radical beams were formed in high concentration. Rotational temperatures of CCl(X) and CN(X) radicals produced from CCl<sub>4</sub>, and CH<sub>3</sub>CN, respectively, were estimated to be ca. 30 K.

Author

*Radicals; Diatomic Molecules; Spectroscopic Analysis; Laser Beams*

**19990009037** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Study of Bubble Nucleation using Molecular Dynamics Method**

Ikegami, Yasuyuki, Kyushu Univ., Japan; Inoue, Takayoshi, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 107-118; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The elementary process of bubble nucleation was studied using a molecular dynamics method with a Lennard-Jones (12-6) potential. After the excess energy was given instantaneously to a portion of molecules in a liquid state, the behavior of molecules and the process of bubble nucleation were observed. Simulations are performed for 400 argon using periodic boundary conditions. Behavior, temperature and pressure of argon are showed in this paper.

Author

*Bubbles; Molecular Dynamics; Nucleation*

*Includes light phenomena; and optical devices. For lasers see 36 Lasers and Masers.*

**19990008466** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Interferometric Fiber Sensors Based on Triangular Phase Modulation**

Lee, Ching-Ting, National Central Univ., Taiwan, Province of China; Chang, Lih-Wuu, National Central Univ., Taiwan, Province of China; Chien, Pie-Yau, Chung Shan Inst. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 305-315; In English

Contract(s)/Grant(s): NSC84-2215-E-008-006; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This work presents three novel signal processing methods capable of accurately detecting the optical phase delay in optical interferometric sensors. In the proposed methods, a triangular waveform modulation signal is used to modulate the optical phase of an optical interferometer for measuring optical phase delay. The optical phase delay in the first method is obtained by integrating the interferometric output signals with the gated-in signal. The optical phase delay in the second method can be measured from the time delay difference between the interferometric signals during the gated-in period. For the third method, the pseudo-heterodyne technique is applied, and the optical phase delay is measured from the phase difference between two output signals. Moreover, a fiber Sagnac interferometric rotation sensor is adopted to demonstrate the effectiveness of the proposed methods. Furthermore, experimental results confirm that the proposed methods have an extreme degree of sensitivity and good linearity.

Author

*Interferometry; Signal Processing; Optical Measuring Instruments; Phase Modulation; Heterodyning; Interferometers*

**19990008582** NASA Johnson Space Center, Houston, TX USA

**Apparatus and Method for Focusing a Light Beam in a Three-Dimensional Recording Medium by a Dynamic Holographic Device**

Juday, Richard D., Inventor, NASA Johnson Space Center, USA; Jun. 16, 1998; 20p; In English

Patent Info.: Filed 5 Apr. 1996; NASA-Case-MS-C-22746-1; US-Patent-5,768,242; US-Patent-Appl-SN-629360; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

An apparatus is disclosed for reading and/or writing information or to from an optical recording medium having a plurality of information storage layers. The apparatus includes a dynamic holographic optical element configured to focus light on the optical recording medium. a control circuit arranged to supply a drive signal to the holographic optical element, and a storage device in communication with the control circuit and storing at least a first drive signal and a second drive signal. The holographic optical element focusses light on a first one of the plurality of information storage layers when driven by the first drive signal on a second one of the plurality of information storage layers when driven by the second drive signal. An optical switch is also disclosed for connecting at least one light source in a source array to at least one light receiver in a receiver array. The switch includes a dynamic holographic optical element configured to receive light from the source array and to transmit light to the receiver array, a control circuit arranged to supply a drive signal to the holographic optical element, and a storage device in communication with the control circuit and storing at least a first drive signal and a second drive signal. The holographic optical element connects a first light source in the source array to a first light receiver in the receiver array when driven by the first drive signal and the holographic optical element connects the first light source with the first light receiver and a second light receiver when driven by the second drive signal.

Official Gazette of the U.S. Patent and Trademark Office

*Light Beams; Focusing; Light Modulators; Holographic Optical Elements; Light Modulation; Communication Equipment*

**19990008606** NASA Lewis Research Center, Cleveland, OH USA

**Integrated Fluorescence**

Tuma, Margaret, Inventor, NASA Lewis Research Center, USA; Gruhlke, Russell W., Inventor, NASA Lewis Research Center, USA; Nov. 24, 1998; 8p; In English

Patent Info.: Filed 11 Jul. 1997; NASA-Case-LEW-16368-1; US-Patent-5,841,143; US-Patent-Appl-SN-903184; No Copyright; Avail: US Patent and Trademark Office, Hardcopy, Microfiche

A detection method is integrated with a filtering method and an enhancement method to create a fluorescence sensor that can be miniaturized. The fluorescence sensor comprises a thin film geometry including a waveguide layer, a metal film layer and sensor layer. The thin film geometry of the fluorescence sensor allows the detection of fluorescent radiation over a narrow wavelength

interval. This enables wavelength discrimination and eliminates the detection of unwanted light from unknown or spurious sources.

Official Gazette of the U.S. Patent and Trademark Office

*Fluorescence; Detection; Miniaturization; Radiation Detectors*

**19990008636** NASA Marshall Space Flight Center, Huntsville, AL USA

**Design of Large Lightweight Space Telescope Optical Systems for the Next Generation Space Telescope**

Jacobson, Dave, NASA Marshall Space Flight Center, USA; Craig, Larry, NASA Marshall Space Flight Center, USA; Schunk, Greg, NASA Marshall Space Flight Center, USA; Shapiro, Alan, NASA Marshall Space Flight Center, USA; Cloyd, Dick, NASA Marshall Space Flight Center, USA; Ricks, Ed, NASA Marshall Space Flight Center, USA; Vacarro, Mark, NASA Marshall Space Flight Center, USA; Redding, Dave, Jet Propulsion Lab., California Inst. of Tech., USA; Hadaway, James, Alabama Univ., USA; Bely, Pierre, Space Telescope Science Inst., USA; 1998; 2p; In English, 20-28 Mar. 1998, Kona, HI, USA; Sponsored by International Society for Optical Engineering, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

The Next Generation Space Telescope (NGST) is currently in a Pre Phase A study effort to prove feasibility of design and to show that the design can be implemented within cost constraint guidelines and meet the requirements of the science community. In an effort to achieve the science communities goals as outlined in "HST and Beyond" the NGST team has developed a government "yardstick" design of an eight meter diameter segmented telescope which would be launched in an Atlas IIAS launch vehicle to a L2 (Lagrange Point) orbit. This paper will discuss the design of the Optical Telescope Assembly (OTA) and the various issues and complications of designing lightweight optics to be placed in the environment that the NGST will encounter both during launch and during its operational mission at L2. The OTA must be lightweight but structurally must withstand the launch environment and transfer to its final L2 orbit. The OTA must be stable at L2 to provide high quality science at the cryogenic temperatures it will experience. The OTA segmented petal concept is to develop lightweight optics which can either be manipulated to achieve and maintain a desired figure or be rigid enough so that change in shape is only necessary for phasing and alignment. The secondary mirror structural mast must also be rigid with frequency responses which are not coupled to spacecraft modes in order to maintain and decenter and despace requirements.

Author

*Telescopes; Design; Cryogenic Temperature; Atlas Launch Vehicles*

**19990008665** NASA Marshall Space Flight Center, Huntsville, AL USA

**MSFC Optical Metrology: A National Resource**

Burdine, Robert, NASA Marshall Space Flight Center, USA; 1998; 1p; In English; Metrology and Calibration, 3-7 Feb. 1998, Pasadena, CA, Langley, VA, USA, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

A national need exists for Large Diameter Optical Metrology Services. These services include the manufacture, testing, and assurance of precision and control necessary to assure the success of large optical projects. "Best Practices" are often relied on for manufacture and quality controls while optical projects are increasingly more demanding and complex. Marshall Space Flight Center (MSFC) has acquired unique optical measurement, testing and metrology capabilities through active participation in a wide variety of NASA optical programs. An overview of existing optical facilities and metrology capabilities is given with emphasis on use by other optical projects. Cost avoidance and project success is stressed through use of existing MSFC facilities and capabilities for measurement and metrology controls. Current issues in large diameter optical metrology are briefly reviewed. The need for a consistent and long duration Large Diameter Optical Metrology Service Group is presented with emphasis on the establishment of a National Large Diameter Optical Standards Laboratory. Proposals are made to develop MSFC optical standards and metrology capabilities as the primary national standards resource, providing access to MSFC Optical Core Competencies for manufacturers and researchers. Plans are presented for the development of a national lending library of precision optical standards with emphasis on cost avoidance while improving measurement assurance.

Author

*Metrology; Optical Measurement; NASA Programs; Quality Control*

**19990008729** Army Topographic Engineering Center, Fort Belvoir, VA USA

**Correcting Radiance Data for Randomly Occurring Nonuniform Illumination of the IFOV of Individual Detectors in Arrays**

Berger, H.; Bosch, E. H.; Simental, E.; Jan. 1998; 8p; In English

Report No.(s): AD-A354844; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper discusses the nonuniform illumination of individual pixels in an array that is intrinsic to the scene viewed, as opposed to turbulence or platform motion as an error source in quantitative imagery. It describes two classes of algorithms to treat



this type of problem. It points out that this problem can be viewed as a type of inverse problem with a corresponding integral equation unlike those commonly treated in the literature. One class allows estimation of the spatial variation of radiance within pixels using the single digital number irradiances produced by the measurements of the detectors within their instantaneous-fields-of-view (IFOVs). Usually it is assumed without discussion that the intrapixel radiance distribution is constant. Results are presented showing the improvements obtained by the methods discussed. Key words: detector array, nonuniform illumination, radiance spatial variation, inverse problem, quantitative imagery.

DTIC

*Algorithms; Correction; Indexes (Documentation); Integral Equations; Irradiance*

**19990008841** Massachusetts Inst. of Tech., Lab. of Electronics, Cambridge, MA USA

**Interferometric Measurement with Squeezed Light** *Annual Report, 1 Jan - 31 Dec. 1998*

Haus, Hermann; Ippen, Erich; Dec. 1998; 10p; In English

Contract(s)/Grant(s): N00014-92-J-1302

Report No.(s): AD-A355745; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Theoretical and experimental investigation of generation of squeezed light using the Kerr effect in fibers. Demonstration of improved sensitivity in interferometric measurement with squeezed light. Development of a theory of quantum optical measurement based on a full quantum mechanical description of the measurement apparatus.

DTIC

*Quantum Theory; Interferometry; Optical Measurement*

**19990009013** Nagoya Inst. of Tech., Japan

**Integrated Wavelength Division Photo-Sensor Using GaAs on Si**

Umeno, Masayoshi, Nagoya Inst. of Tech., Japan; Yang, Ming, Nagoya Inst. of Tech., Japan; Jimbo, Takashi, Nagoya Inst. of Tech., Japan; Shimizu, Hiroaki, Nagoya Inst. of Tech., Japan; Egawa, Takashi, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 121-123; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A new wavelength division photo-sensor, using GaAs on Si by MOCVD, is described. The response of this sensor has a good linear relationship with wavelength of incident light from 620 nm to 900 nm. The sensitivity and the operating wavelength region of the sensor can be easily varied by changing the thickness and the material of the top sensor.

Author

*Wavelengths; Sensitivity; Photometers*

**19990009022** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Photographic Method of Flying Small Particles in High Speed by the Use of Optical Fibers**

Egashira, Torao, Kyushu Sangyo Univ., Japan; Miki, Yutaka, Kyushu Sangyo Univ., Japan; Nanatsue, Kazuhiro, Kyushu Sangyo Univ., Japan; Sakato, Akira, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 81-88; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Small particles flying at high speed apply to the fuel spray of diesel engines, ink jet spray of printers, flying steam in steam turbines, the high speed transport of small powders, etc. In the case of the fuel spray in diesel engines and the ink jet spray the result is phenomena that change from liquid to gas while moving at high speed. In this paper, for the purpose of elucidating high speed phenomena of flying small particles, we experiment with photographic delay pictures by the use of optical fibers as delay medium. The results of this experiment make it clear that the multimode fibers which can transmit a large quantity of energy are very effective for optical pulse lasers as a light source, such as a Ruby laser.

Author

*Optical Fibers; Particles; Fuel Sprays; High Speed Photography; Imaging Techniques*

**19990009086** National Defence Research Establishment, Avdelningen foer Sensorteknik, Linkoeeping, Sweden

**Airborne Optical Sensors: Initial Preparations for Sensor Analyses** *Optiska Flygsensorer: Inledande Analysfoerberedelser*

Renhorn, I., National Defence Research Establishment, Sweden; Carlsson, G., National Defence Research Establishment, Sweden; Engquist, I., National Defence Research Establishment, Sweden; Holm, L., National Defence Research Establishment, Sweden; Hagard, A., National Defence Research Establishment, Sweden; Jan. 1998; 34p; In Swedish

Report No.(s): PB99-103475; FOA-R-98-00715-408-SE; No Copyright; Avail: Issuing Activity (Nat'l Technical Information Service (NTIS)), Microfiche

This progress report accounts for the results obtained during the airborne trials with the TP-86 aircraft and airborne targets. Measurements from these trials constitutes the basis for signature modeling, estimates of environmental effects and the initial sensor analysis. Weather parameters and derived parameters and derived parameters from HIRLAM are being used in transmission calculations using MODTRAN. Satellite data has been stored for the trial period and they will be studied in order to find out if a statistical background scenario can be derived.

NTIS

*Airborne Equipment; Optical Measuring Instruments*

## 75 PLASMA PHYSICS

*Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.*

**19990008656** DYNACS Engineering Co., Inc., Brook Park, OH USA

### **International Space Station Cathode Life Testing Status *Final Report***

Sarver-Verhey, Timothy R., DYNACS Engineering Co., Inc., USA; Soulas, George C., DYNACS Engineering Co., Inc., USA; Oct. 1998; 12p; In English; 34th; Joint Propulsion Conference and Exhibit, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS3-98008; RTOP 022-00-00

Report No.(s): NASA/CR-1998-208677; NAS 1.26:208677; AIAA Paper 98-3483; E-11409; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To demonstrate adequate lifetime and performance capabilities of a hollow cathode for use on the International Space Station (ISS) plasma contactor system, life tests of multiple hollow cathode assemblies (HCAs) were initiated at operating conditions simulating on-orbit operation. Three HCAs are presently being tested. These HCAs are operated with a continuous 6 sccm xenon flow rate and 3 A anode current. Emission current requirements are simulated with a square waveform consisting of 50 minutes at a 2.5 A emission current and 40 minutes with no emission current. As of July 1998, these HCAs have accumulated between 1 1,700 and 14,200 hours. While there have been changes in operation, behavior the three HCAs continue to operate stably within ISS specifications and are expected to demonstrate the required lifetime.

Author

*Hollow Cathodes; International Space Station; Continuum Flow; Flow Velocity; Anodes*

**19990008716** California Univ., Dept. of Electrical and Computer Engineering, San Diego, CA USA

### **Coulomb Crystallization in Dusty Plasmas *Final Report, 1 Apr. 1995 - 30 Jun. 1998***

Rosenberg, Marlene, California Univ., USA; Sep. 30, 1998; 13p; In English

Contract(s)/Grant(s): F49620-95-1-0293

Report No.(s): AD-A354822; AFRL-SR-BL-TR-98-0671; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ionized gases laden with fine charged dust grains are loosely referred to as dusty plasmas. Recently, lattice structures of negatively charged strongly coupled dust grains, called Coulomb crystals, have been formed in several laboratory plasma experiments. This three year project conducted fundamental theoretical research on issues important for understanding the basic physics of Coulomb crystallization in dusty plasmas. Models of the intergrain forces were developed, including attractive induced dipole forces in addition to repulsive screened Coulomb forces, and applied to modeling experimental data. The properties of low frequency dust acoustic waves and instabilities in strongly coupled dusty plasmas were investigated. Novel schemes for forming Coulomb lattices of positively charged grains were developed, involving grains that are charged positively either by ultraviolet (UV)-induced photoemission in a high-pressure gas, or by thermionic emission under laser heating. The use of UV to reduce dust trapping in process plasmas was also explored, and studies began on the use of dust as an electron source resulting from photoemission or thermionic emission. In addition, various waves and instabilities in collisional dusty plasmas were investigated.

DTIC

*Crystallization; Dust; Crystals; Strongly Coupled Plasmas*

**19990008886** DYNACS Engineering Co., Inc., Brook Park, OH USA

**Destructive Evaluation of a Xenon Hollow Cathode after a 28,000 Hour Life Test**

Sarver-Verhey, Timothy R., DYNACS Engineering Co., Inc., USA; Oct. 1998; 18p; In English; 34th; Joint Propulsion Conference and Exhibit, 13-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Architects Foundation, USA

Contract(s)/Grant(s): NAS3-98008; RTOP 022-00-00

Report No.(s): NASA/CR-1998-208678; NAS 1.26:208678; AIAA Paper 98-3482; E-11410; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

International Space Station (ISS) plasma contactor system requires a hollow cathode assembly (HCA) with a lifetime of at least 18,000 hours. In order to demonstrate the lifetime capability of the HCA, a series of hollow cathode wear tests was performed which included a life test operated at the maximum current of the HCA. This test sought to verify hollow cathode lifetime capability and contamination control protocols. This hollow cathode accumulated 27,800 hours of operation before it failed during a restart attempt. The cathode was subsequently destructively analyzed in order to determine the failure mechanism. Microscopic examination of the cathode interior determined that relatively small changes in the cathode physical geometry had occurred and barium tungstates, which are known to limit the emission process, had formed over a majority of the electron emitter surface. Because the final state of the insert was consistent with expected impregnate chemistry, the hollow cathode was believed to have reached the end of its usable life under the test conditions.

Author

*Hollow Cathodes; International Space Station; Emitters; Plasmas (Physics); Tungstates*

**76**

**SOLID-STATE PHYSICS**

*Includes superconductivity. For related information, see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.*

**19990008635** NASA Marshall Space Flight Center, Huntsville, AL USA

**Dielectric Spectroscopy Study of ZnSe Grown by Physical Vapor Transport**

Kokan, J., Georgia Inst. of Tech., USA; Gerhardt, R., Georgia Inst. of Tech., USA; Su, Ching-Hua, NASA Marshall Space Flight Center, USA; 1997; 1p; In English, 3 Dec. 1997, Boston, MA, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

The dielectric properties of ZnSe samples grown by physical vapor transport were measured as a function of frequency. Differences can be seen in the dielectric properties of samples grown under different conditions. The spectra of heat treated samples were also acquired and were found to exhibit significant deviations from those of the as grown crystals.

Author

*Dielectric Properties; Zinc; Selenium; Vapors*

**19990008667** NASA Marshall Space Flight Center, Huntsville, AL USA

**Bulk Growth of Wide Band Gap II-VI Compound Semiconductors by Physical Vapor Transport**

Su, Ching-Hua, NASA Marshall Space Flight Center, USA; 1997; 1p; In English; US-Russian Space STAC, 10-13 Nov. 1997, Huntsville, AL, USA; No Copyright; Avail: Issuing Activity; Abstract Only, Hardcopy, Microfiche

The mechanism of physical vapor transport of II-VI semiconducting compounds was studied both theoretically, using a one-dimensional diffusion model, as well as experimentally. It was found that the vapor phase stoichiometry is critical in determining the vapor transport rate. The experimental heat treatment methods to control the vapor composition over the starting materials were investigated and the effectiveness of the heat treatments was confirmed by partial pressure measurements using an optical absorption technique. The effect of residual (foreign) gas on the transport rate was also studied theoretically by the diffusion model and confirmed experimentally by the measurements of total pressure and compositions of the residual gas. An in-situ dynamic technique for the transport rate measurements and a further extension of the technique that simultaneously measured the partial pressures and transport rates were performed and, for the first time, the experimentally determined mass fluxes were compared with those calculated, without any adjustable parameters, from the diffusion model. Using the information obtained from the experimental transport rate measurements as guideline high quality bulk crystal of wide band gap II-VI semiconductor were grown from the source materials which undergone the same heat treatment methods. The grown crystals were then extensively characterized with emphasis on the analysis of the crystalline structural defects.

Author

*Semiconductors (Materials); Broadband; Pressure Measurement; Vapors; Vapor Phases; Mathematical Models; Heat Treatment; Gas Transport; Electromagnetic Absorption*

**19990008746** Academy of Sciences of the Ukraine, Inst. of Semiconductor Physics, Kiev, Ukraine

**EPR and Electrical Investigations of Point Defects and Hopping Motion in SiC Heavily Doped with Nitrogen *Final Report***

Kalaboukhova, Ekaterina; Jun. 03, 1997; 12p; In English

Contract(s)/Grant(s): F61708-97-W0176

Report No.(s): AD-A353811; EOARD-SPC-97-4051; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking Institute of Semiconductor Physics, National Academy of Sciences, Ukraine.

DTIC

*Doped Crystals; Point Defects; Semiconductors (Materials)*

**19990008834** Los Alamos National Lab., Inst. for Solid State Physics, NM USA

**Fabrication and Testing of Long Length High-Tc Composite Conductors *Final Report***

Fisher, L. M., Los Alamos National Lab., USA; 1998; 104p; In English

Contract(s)/Grant(s): 075-AK-0005-35

Report No.(s): PB99-110157; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Presently some methods of HTS-conductors processing are under study in the authors' laboratory. 'Powder-in-tube' (PIT), 'Jelly-rod', electrophoresis are among them. PIT process has developed predominantly both in a view of the achieved  $J_c$  values Bi-2223 phase was used as a core material for these tapes. Since the main purpose of the task order was to enhance the development of long length high temperature superconductor tapes, the authors have considered reasonable to lay the perfection idea of the PIT process 'step by step' or 'tape by tape'. to realize it the authors have assumed, keeping stable the basic scheme of PIT process, to vary some technological parameters which are as follows: type of initial powder; sheath material; tape construction (filaments number, cross section e.a.); and processing regimes.

NTIS

*Fabrication; Performance Tests; High Temperature Superconductors*

**19990008991** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Synthesis of New Troponoid Liquid Crystals**

Mori, Akira, Kyushu Univ., Japan; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 163-174; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

New liquid crystals with a seven-membered core such as 2-(4-alkoxybenzoyloxy)-5-alkoxytropone, 2-(4-alkoxybenzoyloxy)-5-alkoxytropone, 2-acyloxy-5-alkoxy-tropone, 2,5-diacetyloxytropone, 2-(2-alkenyloxy)-5-alkoxytropone, 5-alkylamino-2-(4-alkoxybenzoyloxy)tropone, and 5-alkoxy-2-(4-alkylaminobenzoyloxy)tropone, were prepared. In these liquid crystals, the tropone carbonyl group played important roles when these compounds exhibit mesophases; it worked as an acceptor of an intramolecular acyl migration, a polar lateral substituent, and an acceptor of an intermolecular hydrogen bond. These features are characteristic of troponoids.

Author

*Synthesis (Chemistry); Liquid Crystals*

**19990009000** Kyushu Univ., Inst. of Advanced Material Study, Kasuga, Japan

**Convection and Solidification with Applications to Crystal Growth**

DeVahl Davis, Graham, New South Wales Univ., Australia; The Reports of Institute of Advanced Material Study, Kyushu University; 1994; ISSN 0914-3793; Volume 8, No. 1, pp. 53-59; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An outline is given of research on the directional solidification of a liquid, and of the effects of natural convection thereon. Three problems which have been studied are described. Finally, current work on solidification in microgravity conditions is discussed.

Author

*Solidification; Crystal Growth; Microgravity; Free Convection; Gravitational Effects*

**19990009009** Nagoya Inst. of Tech., Japan

**Growth of  $\text{YBa}_2\text{Cu}_3\text{O}_{7-y}$  Single Crystals by TSFZ Method**

Suzuki, Ikuo, Nagoya Inst. of Tech., Japan; Maeda, Masaki, Nagoya Inst. of Tech., Japan; Tatebayashi, Kengo, Nagoya Inst. of Tech., Japan; Bulletin of Nagoya Institute of Technology; 1992; ISSN 0918-595X; Volume 44, pp. 151-159; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The traveling solvent floating zone (TSFZ) method has been applied to the growth of  $\text{YBa}_2\text{Cu}_3\text{O}_{7-y}$  (YBCO) single crystals. The optimum composition of the solvent material was chosen from the ternary-phase-diagram of  $\text{YO}_{1.5}$ -BaO-CuO. Some

difficulties were found in the growth process because of the pronounced difference in melting temperatures among YBa<sub>2</sub>Cu<sub>3</sub>O(7-y), BaCuO and CuO, and the very low viscosity of the YBa<sub>2</sub>Cu<sub>3</sub>O(7-y) melt. Thin crystals with dimensions 100 microns x 100 microns x 10 microns were grown on the top surface of the rod of seed materials.

Author

*YBCO Superconductors; Crystal Growth; Single Crystals; Technology Utilization*

**19990009041** Kyushu Univ., Faculty of Engineering, Fukuoka, Japan

**Synthesis of Ultra Pure Higher n-Alkanes up to n-C160H322 and their Crystallization and Thermal Behavior**

Urabe, Yoshiko, Kyushu Univ., Japan; Takamizawa, Kanichiro, Kyushu Univ., Japan; Technology Reports of Kyushu University; Mar. 1994; ISSN 0023-2718; Volume 67, No. 2, pp. 85-93; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The structures stable at room temperature for n-alkanes (abbr. C<sub>n</sub>, n: the number of carbon atoms) are monoclinic for even series and orthorhombic for odd ones, respectively. It has been, however, recognized that for samples having higher homologous purities both the even and odd C<sub>n</sub> transform before their melting to a high temperature structure. Pure samples up to C<sub>66</sub> were solution-crystallized as the monoclinic. C(72) and C(80) were, however, obtained just as the orthorhombic one, despite the high purity. In order to obtain more higher n-alkanes in the region that chain folding is found, Wurtz condensation was performed. The mixture of n-alkanes was separated by GPC repeated runs. DSC curve of C(160) crystals grown from p-xylene solution by slow-cooling revealed that the melting of once-folded chain crystal was immediately followed by recrystallization (exothermic peak) in the extended chain form, which melted at a somewhat higher temperature. The thickness of C(160) crystal about 10 nm from observation by TEM. It could be said that crystals had once-folded was chain structure. The thermal behavior for C(120) crystals was similar to that of C(160).

Author

*Synthesis (Chemistry); Purity; Alkanes; Crystallization; Temperature Effects; Carbon*

**19990009074** NASA Lewis Research Center, Cleveland, OH USA

**Emittance Theory for Cylindrical Fiber Selective Emitter**

Chubb, Donald L., NASA Lewis Research Center, USA; Nov. 1998; 12p; In English; 4th; Thermophotovoltaic Generation of Electricity (TPV4), 11-14 Oct. 1998, Denver, CO, USA; Sponsored by National Renewable Energy Lab., USA

Contract(s)/Grant(s): RTOP 632-1A-1A

Report No.(s): NASA/TM-1998-208656; NAS 1.15:208656; E-11378; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A fibrous rare earth selective emitter is approximated as an infinitely long, cylinder. The spectral emittance,  $e_{\text{sub } x}$ , is obtained by solving the radiative transfer equations with appropriate boundary conditions and uniform temperature. For optical depth,  $K_{\text{sub } R}$ , where  $\alpha_{\text{sub } \lambda}$ , is the extinction coefficient and  $R$  is the cylinder radius, greater than 1 the spectral emittance depths,  $K_{\text{sub } R} \alpha_{\text{sub } \lambda} R$ , is nearly at its maximum value. There is an optimum cylinder radius,  $R_{\text{sub } \text{opt}}$  for maximum emitter efficiency,  $\eta_{\text{sub } E}$ . Values for  $R_{\text{sub } \text{opt}}$  are strongly dependent on the number of emission bands of the material. The optimum radius decreases slowly with increasing emitter temperature, while the maximum efficiency and useful radiated power increase rapidly with increasing temperature.

Author

*Attenuation Coefficients; Optical Thickness; Radiative Transfer; Emitters*

## 81

### ADMINISTRATION AND MANAGEMENT

*Includes management planning and research.*

**19990008480** General Accounting Office, Washington, DC USA

**Testimony Before the Subcommittee on Government Management, Information and Technology, Committee on Government Reform and Oversight, House of Representatives. Forest Service: Financial Management Issues**

Jul. 1998; 10p; In English

Report No.(s): PB99-107013; GAO/T-AIMD-98-231; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This Report discusses the results of the work examining weaknesses in the Forest Service's financial accounting and reporting systems reported by the USA Department of Agriculture's (USDA) Office of Inspector General (IG). The Forest Service has been plagued by continuing financial management problems as evidenced by the IG's adverse opinion on the Forest Service's fiscal year 1995 financial statements. Due to the severity of these problems, the Forest Service did not prepare financial statements for



fiscal year 1996, but chose instead to focus its efforts on problem resolution. Financial statements were prepared for fiscal year 1997, and the audit of those statements is near completion; as of July 1, 1998, the USDA IG was finalizing its report. It will focus primarily on the fiscal year 1995 audit results, which disclosed a number of serious weaknesses, most of which still exist today.

NTIS

*Forest Management; Financial Management; Forests; Management Information Systems; Congressional Reports*

**19990008709** Texas Univ., Austin, TX USA

**Impact of Incentives On Project Performance**

Mitchell, Jayson D.; Aug. 1998; 129p; In English

Report No.(s): AD-A355055; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Aligning both owner and contractor objectives is widely thought to be a catalyst for better project performance. For this very reason, contract incentives are employed in order to identify and ensure focus on the owner's goals. The scope of this report is to research the extent of use and consequent effects of construction contract incentives offered by owners. The relative use by owners of construction phase incentives will be characterized, and an incentive use index assigned to each project. Additionally, the impacts of incentive use in terms of cost, schedule, and safety will be investigated. A relationship between the relative incentive use (incentive index) and project performance will also be examined.

DTIC

*Catalysts; Construction; Contract Incentives; Contractors*

**19990008830** NASA Marshall Space Flight Center, Huntsville, AL USA

**Downsizing: Is There a "Right" Way?**

Tippett, Donald D., Alabama Univ., USA; Childress, Rhonda, NASA Marshall Space Flight Center, USA; Sweitzer, Melissa G, Ente Nazionale Idrocarburi, USA; 1998; 10p; In English; 19th, 1-3 Oct. 1998, Virginia Beach, VA, USA; Sponsored by American Society for Engineering Management, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In response to the pressures of surviving in a competitive global market, many companies are turning to downsizing, right sizing, restructuring, reduction-in-force, and/or business process re-engineering, among others. Regardless of the terminology used, an inevitable result is a loss of jobs. Companies fail to grasp the profound ramifications of downsizing for both the people laid off and the organization and work force that remain after downsizing is complete. A search of the literature was conducted to ascertain what leading theorists and practitioners are saying about downsizing and the "right" way to go about it. This search culminated in the Nine Point Model for Downsizing (NPMD). The model is used to analyze a downsizing case study involving the December 1997 layoff of 19,000 employees by a leading manufacturer of imagine products.

Author

*Commerce; Losses; Personnel*

**19990008846** General Accounting Office, General Government Div., Washington, DC USA

**Credit Cards: Intragovernmental Transfers and Related Concerns**

Aug. 17, 1998; 18p; In English

Report No.(s): PB99-105876; GAO/GGD-98-179R; B-280540; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This letter responds to your request for information on the use of credit cards for intragovernmental transfers and on the General Services Administration's (GSA) new contracts for credit card services. Specifically, you asked for information on (1) how intragovernmental transfers are currently processed using GSA's International Merchant Purchase Authorization Card (IMPAC card) and the Department of the Treasury's Uncle Sam Acquisition card (USA card); (2) issues of concern involving the use of credit cards for intragovernmental transfers and actions being taken to address these issues; and (3) GSA's decision to use multiple contracts to replace the expiring purchase, travel, and fleet credit/charge card contracts.

NTIS

*Management; Cards; Financial Management*

**19990008848** General Accounting Office, General Government Div., Washington, DC USA

**Federal Advisory Committee Act: Views of Committee Members and Agencies of Federal Advisory Committee Issues**

Jul. 09, 1998; 70p; In English

Report No.(s): PB99-105942; GAO/GGD-98-147; B-279404; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

For this report, we surveyed: advisory committee members to obtain their perceptions on the extent to which their committees provided balanced and independent advice and recommendations as required by FACA; federal agencies to obtain their views on the extent to which they found compliance with FACA useful or burdensome, the impact of Executive Order 12838 (which placed

ceilings on the number of advisory committees) on their ability to accomplish their missions, and whether any advisory committees mandated by Congress should be terminated; and advisory committee members and federal agencies on the extent to which they believed the public was afforded access to advisory committee proceedings and a means to express their views to agencies and their advisory committees.

NTIS

*Congressional Reports; Reviewing; Perception*

**19990008849** General Accounting Office, General Government Div., Washington, DC USA

**General Services Administration: Impact of Overestimation of Rental Revenue on the Federal Buildings Fund**

Aug. 1998; 28p; In English

Report No.(s): PB99-105892; GAO/GGD-98-183; B-277993; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report (1) summarizes information the authors developed to verify, to the extent practical, the amounts General Services Administration (GSA) attributed to each reason for overestimation of the Federal Buildings Fund (FBF) rental revenue projections for fiscal years 1996, 1997, and 1998; (2) discusses whether the Public Buildings Services (PBS) corrective actions appeared to address GSA's identified reasons for the overestimation; and (3) discusses the budgetary impact of the overestimation on projects and programs in the FBF.

NTIS

*Revenue; Buildings; Federal Budgets*

**19990008850** General Accounting Office, General Government Div., Washington, DC USA

**Currency Paper Procurement: Meaningful Competition Unlikely under Current Conditions**

Aug. 1998; 130p; In English

Report No.(s): PB99-105884; GAO/GGD-98-181; B-278747; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report addresses (1) the optimum circumstances for the procurement of distinctive currency paper, (2) the effectiveness of the Bureau of Engraving and Printing's (BEP) efforts to encourage competition in the procurement of currency paper, (3) the fairness and reasonableness of prices paid for currency paper by BEP and the quality of the paper purchased, and (4) the potential for disruption to the U.S. currency paper supply from BEP's reliance on a single source. This report contains matters for congressional consideration and recommendations to the Secretary of the Treasury.

NTIS

*Procurement; Competition; Financial Management; Information Systems*

**82**

**DOCUMENTATION AND INFORMATION SCIENCE**

*Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.*

**19990008468** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Generalized Source Coding Theorems and Hypothesis Testing, Part 1, Information Measures**

Chen, Po-Ning, National Chiao Tung Univ., Taiwan, Province of China; Alajaji, Fady, Queens Univ., Canada; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 283-292; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Expressions for Epsilon-entropy rate, Epsilon-mutual information rate and Epsilon-divergence rate are introduced. These quantities, which consist of the quantiles of the asymptotic information spectra, generalize the inf/sup-entropy/information/divergence rates of Han and Verdu. The algebraic properties of these information measures are rigorously analyzed, and examples illustrating their use in the computation of the F-capacity are presented. In Part II of this work, these measures are employed to prove general source coding theorems for block codes, and the general formula of the Neyman-Pearson hypothesis testing type-II error exponent subject to upper bounds on the type-I error probability.

Author

*Coding; Theorems; Hypotheses; Error Analysis; Entropy*

**19990008469** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**Generalized Source Coding Theorems and Hypothesis Testing, Part 2, Operational Limits**

Chen, Po-Ning, National Chiao Tung Univ., Taiwan, Province of China; Alajaji, Fady, Queens Univ., Canada; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 293-303; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In light of the information measures introduced in Part I, a generalized version of the Asymptotic Equipartition Property (AEP) is proved. General fixed-length data compaction and data compression (source coding) theorems for arbitrary finite-alphabet sources are also established. Finally, the general expression of the Neyman-Pearson type-II error exponent subject to upper bounds on the type-I error probability is examined.

Author

*Coding; Data Compression; Hypotheses; Theorems; Equipartition Theorem; Alphabets*

**19990008472** Chinese Inst. of Engineers, Taipei, Taiwan, Province of China

**A Database Application Generator for the WWW**

Lin, Wei-Jyh, National Chengchi Univ., Taiwan, Province of China; Chen, Kung, National Taiwan Univ. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; May 1998; ISSN 0253-3839; Volume 21, No. 3, pp. 337-346; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper describes a database application generator for the WWW called GWB. GWB contains a compact language that adds control structures and database access constructs to HTML, a compiler that translates HTML-like source templates into ODBC code and utilities for authentication and session management. It is designed to ease the expertise requirement needed for developing Web-based intranet and internet database applications. This paper surveys the current approaches; describes the language and its support for authentication and session management; and gives an internet application using GWB. This paper also discusses future enhancement in terms of persistent database connections and server-side client state persistency.

Author

*Data Bases; World Wide Web; Internets; Applications Programs (Computers); Compilers*

**19990008868** Air Univ., Maxwell AFB, AL USA

**Airpower Journal Index 1987-1996**

Petersen, Michael J.; Lang, Pamela; Jul. 1998; 208p; In English

Report No.(s): AD-A355595; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This publication lists all articles, editorials, and short commentaries from the first 10 volumes of Airpower Journal (1987-1996) in author, title, and subject indexes. The subject index-divided into 135 categories-also includes book reviews, listed alphabetically by name of the book's author. The other categories of the subject index list entries alphabetically by title. A typical entry includes the author's name, title of the article/editorial/commentary, volume number, issue number, date of issue, and inclusive page numbers. Articles, editorials, and commentaries may be cross-referenced in as many as five different categories. We used our best judgment in assigning entries to subject categories, although-in the spirit of both inclusiveness and usefulness-we have deliberately placed entries in categories that may be only marginally appropriate. We have retained most of the category titles used in the Airpower Journal Index, 1987-1991 but have added 24 new categories that reflect such changes as the demise of the Soviet Union and the return of Russia, the emergence of information warfare, and the revolution in military affairs.

DTIC

*Indexes (Documentation); Warfare*

**19990008906** Kyushu Sangyo Univ., Faculty of Engineering, Fukuoka, Japan

**Knowledge Representation Forms Based on Conceptual Frames**

Fujita, Takeshi, Kyushu Sangyo Univ., Japan; Bulletin of the Faculty of Engineering, Kyushu Sangyo University; 1993; ISSN 0286-7826, No. 30, pp. 73-80; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents a kind of structural paradigm for representing human knowledge based on conceptual frames. Hierarchical relationship defined by class subsumption gives a partial ordering to the frames that represent concepts as the units of knowledge. A basic mechanism, which is regarded as a generalized unification among those frames, is defined using the hierarchy for joining those frames. Some methods for composing and defining compound frames from basic ones are given using ones are given using recursively the join-operation and logical abstraction.

Author

*Knowledge Representation; Knowledge Based Systems; Frames (Data Processing)*

**19990008934** Space and Naval Warfare Systems Command, San Diego, CA USA

**Information Technology: Strategic Plan**

Jun. 1998; 11p; In English

Report No.(s): AD-A355092; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The members of the Information Technology Steering Group (ITSG) have been meeting since January 1998 to support the Space and Naval Warfare (SPAWAR) Systems Center, San Diego (SSC San Diego) Chief Information Officer (CIO) in the development of high-level vision, strategy, policy, and requirements for corporate information technology (IT). The IT Strategic Plan documents the role that corporate information technology plays in achieving SSC San Diego's mission, vision and goals. This plan defines a vision for SSC San Diego's information technology environment that will enhance the quality of service to its customers and guide the corporate information technology program during the FY 1999 to FY 2001 period. Our next step in the corporate IT planning process is to create a corporate IT Implementation Plan.

DTIC

*Information Systems; Warfare*

**84**

**LAW, POLITICAL SCIENCE AND SPACE POLICY**

*Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.*

**19990009085** National Defence Research Establishment, Huvudavdelning foer Foersvarsanalys, Stockholm, Sweden

**Integration or Break-Down: A Study on the Development of Cooperation within the CIS in 1991-1997** *Integration eller Soenderfall: En Studie av Utvecklingen av Samarbetet inom OSS 1991-1997*

Hagstroem, E., National Defence Research Establishment, Sweden; Feb. 1998; 56p; In Swedish

Report No.(s): PB99-103459; FOA-R-98-00728-180-SE; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

Both integrative and disintegrative tendencies have characterized the Commonwealth of Independent States (CIS) since its formation in December 1991. The aim of this report is to survey the development of institutional, military and economic cooperation within the CIS during 1991-1997 and to throw light on the member countries' policies on cooperation within the CIS.

NTIS

*Surveys; Commonwealth of Independent States*

**89**

**ASTRONOMY**

*Includes radio, gamma-ray, and infrared astronomy, and astrometry.*

**19990008969** Observatoire de Paris-Meudon, France

**New Perspectives on Solar Prominences: IAU Colloquium 167, Volume 150**

Oct. 13, 1998; 536p; In English; New Perspectives on Solar Prominences, 28 Apr. - 4 May 1997, Aussois, France

Contract(s)/Grant(s): F61708-97-WE037

Report No.(s): AD-A355859; EOARD-CSP-97-1007; ISBN 1-886733-70-8; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche

The IAU Colloquium 167: New Perspectives on Solar Prominences was held in Aussois, France from April 28 to May 3, 1997. The purpose of the meeting was to review, discuss and try to understand the new observations of prominences and their environment. One hundred and seven scientists from twenty-one countries participated.

DTIC

*Solar Prominences; Sun*

**19990009047** Columbia Univ., New York, NY USA

**ASCA Observations Final Report, 1 Apr. 1994 - 30 Sep. 1998**

Helfand, David J., Columbia Univ., USA; Oct. 1998; 6p; In English

Contract(s)/Grant(s): NAG5-2556

Report No.(s): CAL-3056; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This recently expired grant has supported the work of the PI, his students, and his collaborators on a variety of ASCA projects over the past four years. Annual reports have summarized much of the work accomplished; here we provide a brief review of the work resulting from this effort, and a summary of the personnel who have benefited from the grant's support. Starburst Galaxies with Extreme X-ray Luminosities This project began as a careful examination of the claims of Boller et al. (1992) that there were dozens of "normal" galaxies in the ROSAT All-Sky Survey that had X-ray luminosities in excess of  $10^{42}$  erg sec, higher than that seen in the hundreds of non-AGN galaxies observed with Einstein. If true, this suggested that X-ray emission associated with star formation activity might have a significant contribution to make to the still unexplained cosmic X-ray background (XRB). Since some of our earlier work with the Einstein Observatory Deep Surveys had suggested a similar possibility and several sets of authors over the years had modelled the starburst XRB contribution, these claims were worth pursuing. Our work expanded the examination beyond the RASS to include earlier claims of high-luminosity galaxies powered by starburst emission (selected in this case on the basis of the far-IR luminosities). The result of extensive followup observations under several programs using ROSAT, ASCA, and ground-based facilities was to show that nearly all of these objects in fact have hidden AGN at their cores, and that their luminosities are not in any way extraordinary.

Author

*Starburst Galaxies; X Rays; Star Formation; ROSAT Mission; Galaxies; Far Infrared Radiation; Background Radiation*

## 90 ASTROPHYSICS

*Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also 75 Plasma Physics.*

**19990008462** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

### **Radar Observations of Asteroid 1620 Geographos**

Ostro, Steven J., Jet Propulsion Lab., California Inst. of Tech., USA; Jurgens, Raymond F., Jet Propulsion Lab., California Inst. of Tech., USA; Rosema, Keith D., Jet Propulsion Lab., California Inst. of Tech., USA; Hudson, R. Scott, Washington State Univ., USA; Giorgini, Jon D., Jet Propulsion Lab., California Inst. of Tech., USA; Winkler, Ron, Jet Propulsion Lab., California Inst. of Tech., USA; Yeomans, Donald K., Jet Propulsion Lab., California Inst. of Tech., USA; Choate, Dennis, Jet Propulsion Lab., California Inst. of Tech., USA; Rose, Randy, Jet Propulsion Lab., California Inst. of Tech., USA; Slade, Martin A., Jet Propulsion Lab., California Inst. of Tech., USA; Howard, S. Denise, Jet Propulsion Lab., California Inst. of Tech., USA; Scheeres, Daniel J., Jet Propulsion Lab., California Inst. of Tech., USA; Mitchell, David L., Jet Propulsion Lab., California Inst. of Tech., USA; ICARUS; 1996; ISSN 0019-1035; Volume 121, pp. 46-66; In English

Report No.(s): Rept-0071; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Goldstone radar observations of Geographos from August 28 through September 2, 1994 yield over 400 delay-Doppler images whose linear spatial resolutions range from approx. 75 to approx. 151 in, and 138 pairs of dual-polarization (OC, SC) spectra with one-dimensional resolution of 103 m. Each data type provides thorough rotational coverage. The images contain an intrinsic north/south ambiguity, but the equatorial view allows accurate determination of the shape of the radar-facing part of the asteroid's pole-on silhouette at any rotation phase. Sums of co-registered images that cover nearly a full rotation have defined the extremely elongated shape of that silhouette. Here we present individual images and co-registered sums over approx. 30 deg of rotation phase that show the silhouette's structural characteristics in finer detail and also reveal numerous contrast features "inside" the silhouette. Those features include several candidate craters as well as indications of other sorts of large-scale topographic relief, including a prominent central indentation. Protuberances at the asteroid's ends may be related to the pattern of ejecta removal and deposition caused by the asteroid's gravity field. The asteroid's surface is homogeneous and displays only modest roughness at centimeter-to-meter scales. Our estimates of radar cross section and the currently available constraints on the asteroid's dimensions are consistent with a near-surface bulk density between 2 and 3 g/cu cm. The delay-Doppler trajectory of Geographos' center of mass has been determined to about 200 m on August 28 and to about 100 m on August 31, an improvement of two orders of magnitude over pre-observation ephemerides.

Author

*Radar Tracking; Asteroids; Doppler Effect; Images; Spatial Resolution; Data Acquisition; Display Devices*

**19990008602** Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

### **Proper Motion of Components in 4C 39.25**

Guirado, J. C., Jet Propulsion Lab., California Inst. of Tech., USA; Marcaide, J. M., Valencia Univ., Spain; Alberdi, A., Instituto de Astrofísica de Andalucía, Spain; Elosegui, P., Harvard-Smithsonian Center for Astrophysics, USA; Ratner, M. I., Harvard-



Smithsonian Center for Astrophysics, USA; Shapiro, I. I., Harvard-Smithsonian Center for Astrophysics, USA; Kilger, R., Institut fuer Angewandte Geodaesie, Germany; Mantovani, F., Istituto di Radioastronomia, Italy; Venturi, T., Istituto di Radioastronomia, Italy; Rius, A., Consejo Superior de Investigaciones Cientificas, Spain; Ros, E., Valencia Univ., Spain; Trigilio, C., Istituto di Radioastronomia, Italy; Whitney, A. R., Northeast Radio Observatory Corp., USA; Astronomical Journal; Dec. 1995; ISSN 0004-6256; Volume 110, No. 6, pp. 2586-2596; In English

Contract(s)/Grant(s): DGICYT-PB89-0009; NSF AST-93-03527; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

From a series of simultaneous 8.4 and 2.3 GHz VLBI observations of the quasar 4C 39.25 phase referenced to the radio source 0920+390, carried out in 1990-1992, we have measured the proper motion of component b in 4C 39.25:  $\mu(\text{sub } \alpha) = 90 \pm 43$  (mu)as/yr,  $\mu(\text{sub } \beta) = 7 \pm 68$  (mu)as/yr, where the quoted uncertainties account for the contribution of the statistical standard deviation and the errors assumed for the parameters related to the geometry of the interferometric array, the atmosphere, and the source structure. This proper motion is consistent with earlier interpretations of VLBI hybrid mapping results, which showed an internal motion of this component with respect to other structural components. Our differential astrometry analyses show component b to be the one in motion. Our results thus further constrain models of this quasar.

Author

*Observation; Quasars; Very Long Base Interferometry*

**19990008828** Search for Extraterrestrial Intelligence Inst., Moffett Field, CA USA

**The Mid-Infrared Spectrum of the Galactic Center: A Starburst Nucleus**

Simpson, J. P., Search for Extraterrestrial Intelligence Inst., USA; Witteborn, F. C., Search for Extraterrestrial Intelligence Inst., USA; Cohen, M., California Univ., USA; Price, S. D., Air Force Research Lab., USA; 1998; 12p; In English

Contract(s)/Grant(s): NCC2-900; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using the Michelson interferometer on the Midcourse Space Experiment (MSX), we have taken spectra of many positions in the central 25 min of the Galactic Center (GC) with a 6 min x 9 min FOV. The spectral coverage was 380 to 1700/ cm (6 to 26 microns) and the resolution was approx. 21/cm. The spectra exhibit strong UIR/PAH features at 6.2, 7.7, 8.6 and 11.3 microns, in addition to the ionic lines of (Ne II), at 12.8 microns, (S III) 18.7 microns, and (Ar II) 6.98 microns. There are deep silicate absorption features at 10 and 18 microns and a cold continuum increasing at the longest wavelengths. Additional weak features are present in the spectra. We discuss the variation in the extinction at 10 microns as a function of location in the GC. Compared to the MSX spectrum of the Orion nebula, smoothed to the same resolution and multiplied by the estimated GC extinction, the GC spectra have similar PAH features, but the Orion Nebula also has strong lines of (He III) 15.6 microns, (S IV) 10.5 microns, and (Ar III) 8.99 microns and its 25 microns continuum is stronger (colder). Thus, the GC exhibits the mid-IR spectrum of a low excitation H II region and a nearby molecular cloud with a surface photodissociation region (PDR). This is in excellent agreement with the canonical model of a starburst nucleus in which the hot stars and molecular clouds are randomly distributed. The outer surfaces of the clouds are photodissociated and ionized by the photons from the stars located outside the clouds. The PAH molecules are transiently heated by the stellar photons. Since the exciting stars are located well outside the clouds, the radiation field is dilute compared to a newly-formed blister H II region like Orion; this dilute radiation field causes the relatively low excitation of the ionic lines.

Author

*Infrared Radiation; Spectra; Galactic Radiation; Starburst Galaxies; Orion Nebula; H II Regions*

## 91

### LUNAR AND PLANETARY EXPLORATION

*Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.*

**19990008862** NASA Marshall Space Flight Center, Huntsville, AL USA

**An Overview of Mars Vicinity Transportation Concepts for a Human Mars Mission**

Dexter, Carol E., NASA Marshall Space Flight Center, USA; Kos, Larry, NASA Marshall Space Flight Center, USA; 1998; 7p; In English; 10th; Propulsion, 26-27 Oct. 1998, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

To send a piloted mission to Mars, transportation systems must be developed for the Earth to Orbit, trans Mars injection (TMI), capture into Mars orbit, Mars descent, surface stay, Mars ascent, trans Earth injection (TEI), and Earth return phases. This paper presents a brief overview of the transportation systems for the Human Mars Mission (HMM) only in the vicinity of Mars. This includes: capture into Mars orbit, Mars descent, surface stay, and Mars ascent. Development of feasible mission scenarios

now is important for identification of critical technology areas that must be developed to support future human missions. Although there is no funded human Mars mission today, architecture studies are focusing on missions traveling to Mars between 2011 and the early 2020's.

Author

*Mars Surface; Mars Atmosphere; NASA Space Programs; Mars Exploration*

**19990009038** Search for Extraterrestrial Intelligence Inst., Moffett Field, CA USA

**Comminution of Aeolian Materials on Mars Final Report**

Marshall, John R., Search for Extraterrestrial Intelligence Inst., USA; Jun. 15, 1998; 17p; In English

Contract(s)/Grant(s): NAGw-4353

Report No.(s): NASA/CR-1998-208221; NAS 1.26:208221; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The research task had a two-year performance period for the investigation of aeolian processes on Mars. Specifically, we were investigating the comminution of sand grains as individual particles, and as bulk populations. Laboratory experiment were completed for the individual particles, and results led to new theory for aeolian transport that is broadly applicable to all planetary surfaces. The theory was presented at the LPSC and the GSA in 1998 and 1997 respectively. Essentially, the new theory postulates that aeolian transport is dependent upon two motion thresholds- an aerodynamic threshold and a bed-dilatancy threshold.

Author (revised)

*Mars Surface; Comminution; Planetary Surfaces; Planetary Geology*

## 92

### SOLAR PHYSICS

*Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.*

**19990008887** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Direct Acceleration of Pickup Ions at The Solar Wind Termination Shock: The Production of Anomalous Cosmic Rays**

Ellison, Donald C., North Carolina State Univ., USA; Jones, Frank C., NASA Goddard Space Flight Center, USA; Baring, Matthew G., Universities Space Research Association, USA; 1998; 18p; In English; Sponsored in part by a Compton Fellowship; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We have modeled the injection and acceleration of pickup ions at the solar wind termination shock and investigated the parameters needed to produce the observed Anomalous Cosmic Ray (ACR) fluxes. A non-linear Monte Carlo technique was employed, which in effect solves the Boltzmann equation and is not restricted to near-isotropic particle distribution functions. This technique models the injection of thermal and pickup ions, the acceleration of these ions, and the determination of the shock structure under the influence of the accelerated ions. The essential effects of injection are treated in a mostly self-consistent manner, including effects from shock obliquity, cross-field diffusion, and pitch-angle scattering. Using recent determinations of pickup ion densities, we are able to match the absolute flux of hydrogen in the ACRs by assuming that pickup ion scattering mean free paths, at the termination shock, are much less than an AU and that modestly strong cross-field diffusion occurs. Simultaneously, we match the flux ratios  $\text{He}^{+}/\text{H}^{+}$  or  $\text{O}^{+}/\text{H}^{+}$  to within a factor approx. 5. If the conditions of strong scattering apply, no pre-termination-shock injection phase is required and the injection and acceleration of pickup ions at the termination shock is totally analogous to the injection and acceleration of ions at highly oblique interplanetary shocks recently observed by the Ulysses spacecraft. The fact that ACR fluxes can be modeled with standard shock assumptions suggests that the much-discussed "injection problem" for highly oblique shocks stems from incomplete (either mathematical or computer) modeling of these shocks rather than from any actual difficulty shocks may have in injecting and accelerating thermal or quasi-thermal particles.

Author

*Angular Distribution; Acceleration (Physics); Ion Scattering; Ion Injection; Solar Wind; Cosmic Rays*

93  
**SPACE RADIATION**

*Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see 52 Aerospace Medicine. For theory see 73 Nuclear and High-Energy Physics.*

**19990009040** Kyushu Univ., Faculty of Engineering, Fukuoka, Japan

**Characteristics of a Charged Particle Detector System Investigated by Cosmic Rays**

Budihardjo, Sutomo, Kyushu Univ., Japan; Yamashita, Michihiro, Kyushu Univ., Japan; Iwamoto, Osamu, Kyushu Univ., Japan; Nohtomi, Akihiro, Kyushu Univ., Japan; Uozumi, Yusuke, Kyushu Univ., Japan; Sakae, Takeji, Kyushu Univ., Japan; Matoba, Masaru, Kyushu Univ., Japan; Technology Reports of Kyushu University; Mar. 1994; ISSN 0023-2718; Volume 67, No. 2, pp. 95-102; In Japanese; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Cosmic rays were used to investigate the characteristics of a charged particle detector system (consisting of a NaI (Tl) scintillation detector, a plastic scintillation detector and measuring electronics) for nuclear reaction experiments. Two-detector coincidence measurements were performed to confirm the cosmic-ray detection. Obtained result indicated some evidences of muon detection by this system. Time resolution for two-detector coincidence of this system was estimated at about 200 ns in full width at half maximum (FWHM) of time-response spectra.

Author

*Charged Particles; Radiation Counters; Scintillation Counters*



# Subject Term Index

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